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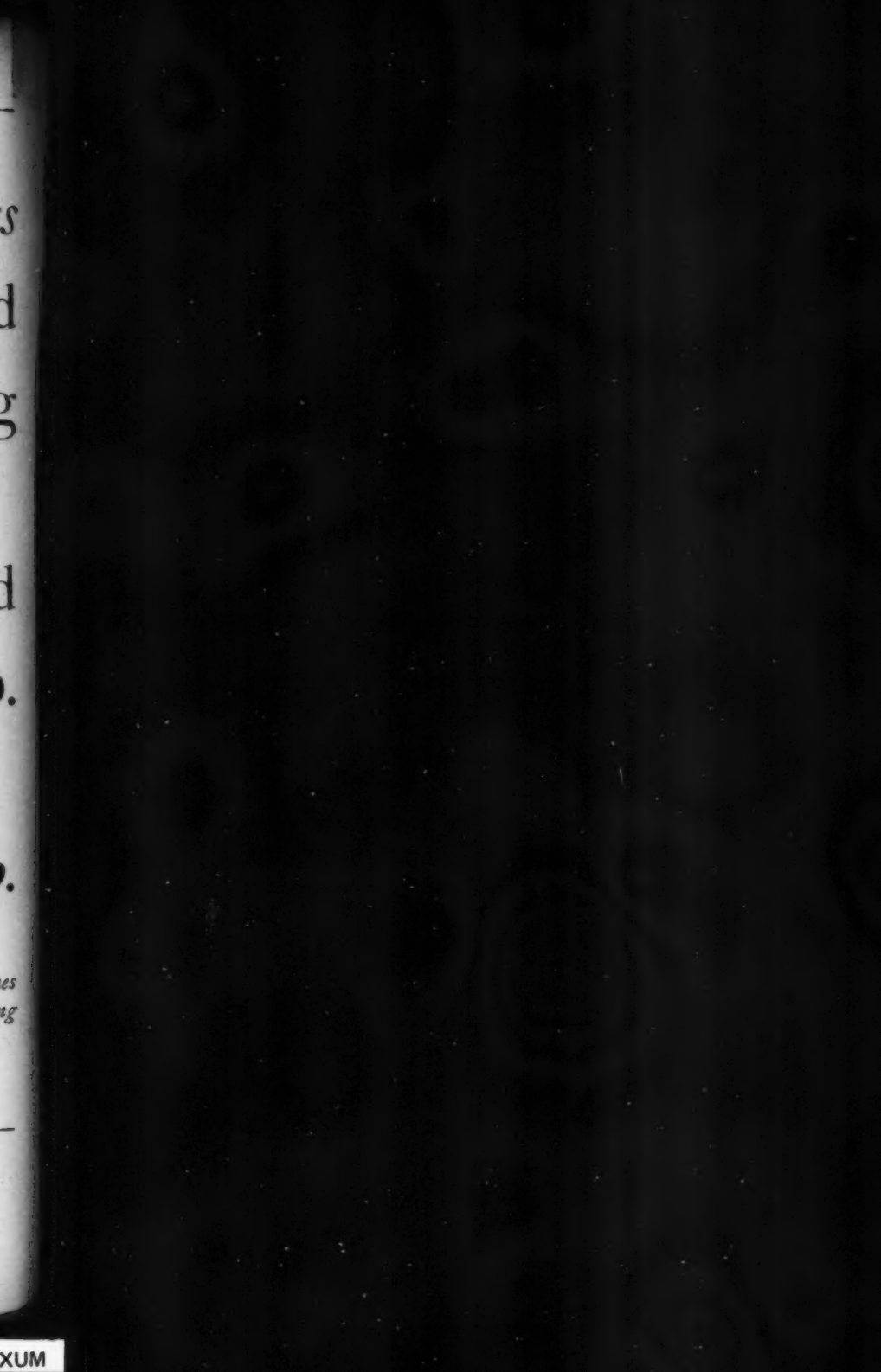

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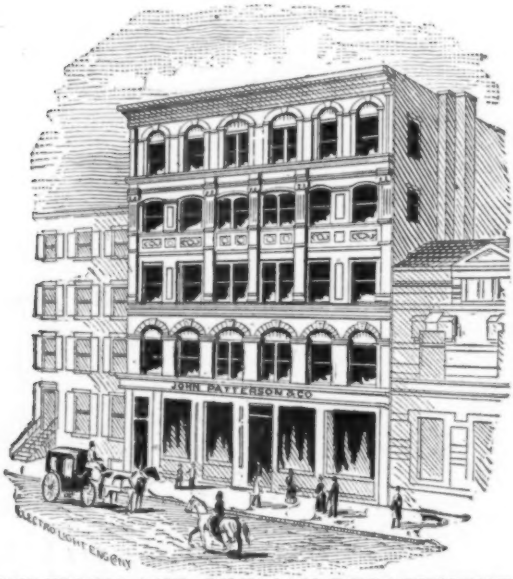

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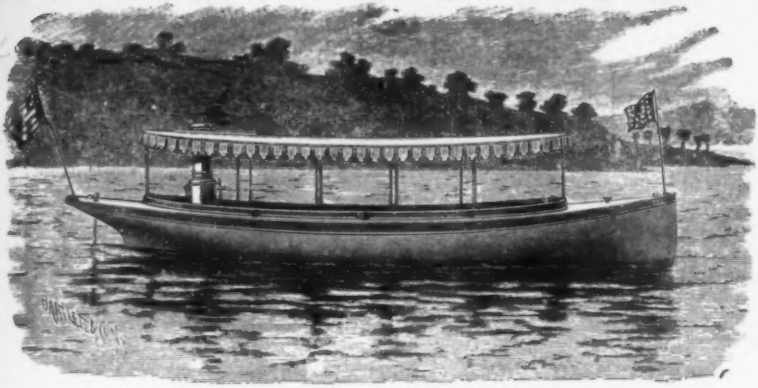

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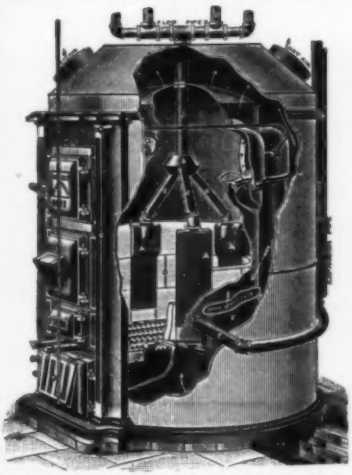

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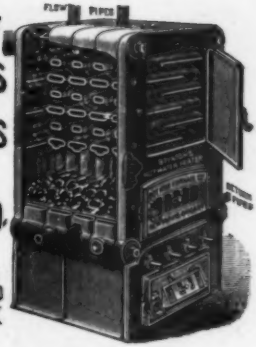

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"I cannot help plead to my countrymen, at every opportunity, to cherish all that is manly and noble in the military profession, because Peace is enervating and no man is wise enough to foretell when soldiers may be in demand again."—SHERMAN.

VOL. XII. NOVEMBER, 1891. NO. LIV.

MOUNTED INFANTRY.*

BY LIEUT. JULIUS A. PENN, JR., 13TH U. S. INFANTRY.

"All cavalry in the future, all mounted troops, ought to be mounted infantry, that is to say, all mounted troops ought to be armed with long range guns, carbines or rifles, and with little else, and be prepared to do most of the fighting on foot. In my four years' experience as a cavalry officer,—as a company, battalion, regimental, brigade and division commander, participating in most of the operations of General Lee's Army of Northern Virginia; and from January, 1865, to the surrender in May, with Gen. J. E. Johnston,—I rarely had occasion to use either the sabre or pistol." (Gen. M. C. Butler, late C. S. A.)

"The ideal cavalryman of the past will have no place in the field in the wars of the future; self-preservation will lead him to demand the long-range weapon, and he will of necessity prefer to be on the ground when he uses it." (Gen. August V. Kautz, U. S. Army.)

MOUNTED Infantry, in the ordinary acceptation of the term in our service, refers to infantry mounted upon horses and still retaining their distinctive arms, accoutrements, and equipment; using their horses merely as a means of moving rapidly from one point to another in the theatre of operations or upon the field of battle. A more general definition would cover the cases of infantry mounted upon wagons, carts, bicycles, or cars, and these will be referred to incidentally to show how far the object may be attained by the use of such means.

*Graduating thesis at the U. S. Infantry and Cavalry School. Publication in the JOURNAL OF THE MILITARY SERVICE INSTITUTION authorized and recommended by the staff of the school. The writer is alone responsible for the views expressed in the essay.

OBJECT OF MOUNTED INFANTRY.

1. To provide a force of trained infantry to accompany cavalry, or horse artillery, or to act alone, where great rapidity of movement is required, and when the fire action is greater than could be obtained by the dismounted fire action of cavalry.

2. To provide, in the absence of cavalry, or when there is an insufficient force of cavalry, a force of mounted troops to carry on the duties of reconnoitring, patrolling, outposts, advanced and rear guards, and kindred duties;—the essential difference between the mounted infantryman and the cavalryman being that the former is armed with the rifle and his function is to fight on foot, while the latter has the carbine or short rifle and possesses both the power to fight on foot and to engage in a mounted combat with sabre, pistol, or lance.

The primary essential of mounted infantry is mobility—rapidity of movement. We must, therefore, first consider the means of obtaining this essential—the means of transportation—and their relation to the objects to be attained by the use of mounted infantry.

WAGONS.

The advantages to be claimed for wagons drawn by two or four horses, as a means of rapid transportation for infantry, are that they would require no special equipment, no alteration of uniform, practically no preliminary instruction, and that the only regulations necessary would be a specification of the amount of baggage to be carried (to check the natural inclination of the men to carry too much), and a few simple rules for loading and unloading, and for crossing bits of rough country. For special cases, wagons can be, and have been, advantageously employed to enable the troops in rear to make long forced marches on the eve of battle. The wagons so used could afterwards be utilized for removing the sick and wounded to the rear, and for hauling supplies of food and ammunition. If we desire, however, to keep such a force of mounted infantry always available—always ready—it is necessary to have the wagons permanently assigned to the regiments and companies using them, and thus all trouble with quartermasters about a supply of wagons when they are needed would be obviated. Each organization should have its quota of wagons, and these should be kept intact, and not used for other purposes except in cases of great emergency.

A special form of wagon was devised a few years ago by a Mr. Schmelzer, and was experimented with at Fort Leavenworth, Kansas, by a board of officers. The wagon was so arranged that the body could be uncoupled from the running gear, and would, upon being uncoupled, dump the load to the rear. The bed of the wagon body was lined with thin sheet steel and was bullet-proof. The wagon bed, when inclined, acted as a shield to protect its squad from a direct attack. The fore-wheels could be uncoupled, and with the team be taken to cover in rear. It was proposed to use the wagons on the line of battle, and also in protecting the rear of a column. The board found that while the wagon could be used advantageously for defense and rapid disembarkation, it was cumbersome and possessed many impracticable features, and that exceptionally favorable conditions were necessary to make its use a success.

A scheme was proposed to the late Tactical Board for mounting infantry upon wagons; and, though I have been unable to obtain a detailed account of the same, I am able to give its general features. The scheme was to mount the infantry upon wagons, or carts, similar to the Irish jaunting cars, or carts, which are sometimes used by the British soldiers in Ireland. If an ordinary transport wagon be utilized, an arrangement similar to the jaunting car, with two longitudinal seats, back to back, in the centre of the wagon, should be used, each seat being capable of holding seven men, and one man riding with the driver. If a two-wheeled cart, then four men on a seat or eight in all. With a four-wheeled car, from twelve to sixteen men. The captain, lieutenants and trumpeters of each company to be mounted on horses. Four such wagons would carry a company of sixty men. Their baggage and all the ammunition they could possibly need, could be carried in the "well" under the seats. The men could disembark at a moment's notice. Few men would be needed to hold the teams —in fact, for a company of sixty men with four wagons, four men would hold the teams, one trumpeter the officers' horses, and four men would form the guard, leaving fifty-one out of sixty for the firing line, as against forty-five in case our infantry were mounted on horses and followed the present rule in our cavalry, of one man holding his own and three other horses. The saving in horses is apparent. The company would use about twenty, as against from sixty to sixty-five in case each man were mounted. The Tactical Board was inclined to favor the scheme, but did not

see fit to embody it in the new drill regulations. The wagons would, of course, generally be confined to the roads, but it was intended to make them of such strength of running gear as to enable them to go wherever artillery could.

General Merritt remarks*: "If wagons drawn by horses or mules will accomplish the same work as expeditiously and more economically, why mount the infantry upon horses? A force of this kind would be most expensive—would never become cavalry and might degenerate into very poor infantry. Besides, two animals will transport in wagons six or more men with their arms and equipments, a great gain over what they will carry. Also men and wagons can be used elsewhere when the exigency, which, at best, can only be temporary, and which even in a long war may occur infrequently, for the use of mounted infantry, has passed."

The use of wagons is open to the serious objections that they must almost invariably follow the roads; that they can seldom be taken across country; and, that the roads on which they would be compelled to move could easily be blocked by fallen timber, destroyed bridges, or they might be rendered impassable for wagons by reason of mud, sand, or long supply trains.

Wagons have been frequently used for the rapid conveyance of small bodies of infantry in our Indian campaigns. In the campaign of 1878, against the band of Northern Cheyennes, which had escaped from the Indian Territory and was on its way North, every means was used to hasten the movements of the infantry. We find the following account of part of the pursuit: "In spite of all precautions, however, on October 4th, the Cheyennes crossed the Union Pacific Railway at Alkali Station, a considerable distance east of Fort Sidney. Within an hour after receipt of the news, Major Thornburgh, with the troops at Sidney, was on board of a train hastening towards the place of the crossing. Captain Mauck, with the troops following on the trail from the department of the Missouri, arrived only a few hours later. Major Thornburgh with his small detachment of cavalry and mounted infantry, pushed ahead rapidly upon the trail, the rest of the infantry following in wagons as fast as they could, through a very difficult country, selected by the Indians, full of high hills of soft sand and destitute of water and grass. All of Thorn-

* In JOURNAL OF THE MILITARY SERVICE INSTITUTION for September, 1889, p. 530.

burgh's wagons were soon abandoned and his troops pushed on from October 6th to October 10th with only such supplies as could be carried on their horses."

In the following year (1889) when Major Thornburgh's command was surrounded on Milk River by the hostile Utes, the relief column made good use of wagons. We quote from the official records*:

"The couriers sent out on the night of September 29th succeeded in getting through safely. As quickly as possible after receipt of orders at Fort D. A. Russell, Wyoming, Colonel W. Merritt, with troops "A," "B," I" and "M," 5th Cavalry, was upon a special train for Rawlins. From this point by a march of almost unparalleled rapidity, in something over forty-eight hours, Colonel Merritt's column, consisting of three hundred and fifty men, one hundred and thirty-one of whom were infantry following in wagons, marched one hundred and seventy miles over a most difficult road and reached the command at Milk River at half-past five o'clock in the morning on October 5th."

After such a brilliant example, no one can doubt the utility of wagons for the rapid movement of small bodies of infantry. As examples of their usefulness when larger bodies of infantry are concerned, we will quote two instances of their use in the Napoleonic wars. Allison, speaking of the march of the French troops towards Bavaria in 1805, says: "Relays of horses were provided to convey by post those who were more remote. Twenty thousand carriages were collected for their rapid conveyance, and the immense host converged by different routes through France, Flanders, and the north of Germany, upon Ulm."

Thiers, speaking of the events preceding the battle of Jena and the assembling of the troops in September, 1806, says: "The Imperial Guard had travelled post, as we have seen, thanks to the relay of carts prepared upon the road. In this manner three thousand grenadiers and dismounted chasseurs had been dispatched. As this mode of conveyance could not be employed for the cavalry and the artillery, the mounted grenadiers and chasseurs forming nearly three thousand horse, as well as the park of Artillery of the Guard amounting to forty pieces, were forwarded by the usual way."

Napoleon was the master of the Art of War. He neglected no

* "Record of Engagements with Hostile Indians within Division of the Missouri from 1868 to 1882." p. 92.—(2).—Same, p. 103.

precaution that would increase the mobility of his army; and by this increased mobility and rapidity he secured much that would otherwise have been lost. The conditions of warfare have been altered since Napoleon's time by railroads, but while the exigencies may be often met by the use of railroads, it is well enough to know what can be done, when the latter are wanting, by the use of wagons.

For the carrying out, therefore, of the first object of Mounted Infantry, we see that wagons and carts, while not fulfilling every requirement, have many advantages. As regards the second object, they cannot be considered.

BICYCLES AND TRICYCLES.

The use of bicycles and tricycles for military purposes has been suggested by various writers; but their value in this respect is, as yet, a most uncertain quantity. The English seem to have taken the lead in the matter of experiment. After making a small experiment in the Easter manœuvres of 1887, they made a more pretentious endeavor in 1888. The scheme was as follows: "A cyclists party, fully armed and accoutred, was dispatched from Guildford with orders to report themselves with the greatest possible expedition at Salisbury, a distance of sixty miles, where they were to take part in the military operations on Saturday. They were then to retire on Winchester and from thence return to Dover via Portsmouth and Eastbourne to take part in the operations there on Monday. * * * The weather was severe. Torrents of rain, head winds and bad roads dogged them through every mile of their march. Yet out of the sixty who left Guildford on the Friday morning, two-thirds arrived in Salisbury, sixty miles away, in fighting condition the same night under circumstances under which no other troops in the world could have done the same. Even out of these disasters they plucked a valuable experience, for some of the number finding themselves belated, took their machines partly to pieces, packed them in a passing passenger train (when horses for want of horse boxes must have stopped) and caught up with their comrades. They took part in the military movements in the neighborhood of Salisbury on Saturday, and those of them who started from Salisbury Saturday evening were in the fight on Dover Downs, one hundred and twenty miles distant, on Monday.

"Since the above experiment, other experiments have been

made at Aldershot. Cyclists corps have been organized in connection with volunteers corps. A special drill has been authorized. Special machines have been made and fitted with all the requirements or requisites of the field,—compasses, glasses, signalling flags, etc., and out of the double tandem a multiple machine has been devised capable of carrying with great expedition from twelve to twenty cyclists, and of being rapidly subdivided, in case of need or injury to part, into sets of double tandems each capable of carrying four, all the parts being interchangeable and interlockable. Great speed has been thus attained and many feats of cross-country travelling over the rough and furze-covered surface in the neighborhood of Aldershot have been proved to be within its capacity. It cannot do what some people seem to expect, climb over the roof of a house, but enough has been shown to prove that in the multiplication of motors and the equalization which numbers give, there is a considerable averaging of the difficulties which would beset a single cyclist."*

The advantages to be claimed for the wheel are rapidity of movement, endurance, indestructability of the means of locomotion, and no necessity for forage; while, no horse-holders being needed, full strength can be used in an attack. The machines can be used as a means of defense against cavalry. Cyclists could be armed with the rifle, and could carry it about as easily as they could the carbine. Its disadvantages are that it requires good hard roads; it cannot be taken across country if the latter be very broken or wooded; and, very large burdens cannot be carried.

It is the intention of the English to use the cyclist companies in screening and reconnoitring duties in connection with, or in the absence of, cavalry; and in fairly open country with plenty of good roads, these duties could no doubt be easily accomplished. The more sanguine hope to make use of considerable bodies of light infantry thus mounted in making raids, extensive turning movements, and similar operations.

In our own country we find very few districts where bicycle companies would be of any practicable value, on account of the general badness of the roads. In some of the older States, where turnpikes are plentiful, small bodies of infantry mounted on bicycles might be advantageously used in reconnoitring, screening, and courier duty, and it is in these same States that we find the largest number of experienced wheelmen. The cyclists of

* *Outing* for December, 1890, p. 194.

this country are of a class of men who would make the best of reconnoitrers and couriers. Young, of splendid physique, in good training physically and mentally, and possessing far more than the ordinary degree of intelligence, with a quick eye for the topographical features, and a knowledge of the importance of good maps and how to read them, gained from experience, they fulfill every requirement.

Last year the League of American Wheelmen reported a membership of over 12,000; and as large numbers of our cyclists do not belong to that organization, we may consider it a very low estimate to place the number of experienced wheelmen in this country to-day at 25,000. From such a source as this, an abundant supply of experienced men could be obtained for service should the country demand it.

In case of trouble with either of our neighbors, Canada or Mexico, small bodies of infantry mounted upon bicycles could be well used. Canada, for a summer campaign, would afford fairly good roads; in Mexico the services of such infantry would be especially valuable on account of the extreme difficulty of supplying large numbers of cavalry horses with water in that arid and inhospitable country. In many cases the courier duty that could be performed would be invaluable. Over a hundred miles a day could be easily covered on anything like good roads. The following table from the Road Records Association of England for 1888 will give an excellent idea of the comparative speed of the different types of machines.*

	50 miles.	100 miles.	12 hours. miles.	24 hours. miles.
Ordinary bicycle.....	2 h. 57 m. 47 s.	6 h. 48 m. 18 s.	.....	273
Safety "	2 h. 47 m. 36 s.	6 h. 30 m. 26 s.	.....	297
" tandem.....	2 h. 52 m. 03 s.	.....	.....	.....
Tricycle.....	2 h. 53 m. 05 s.	6 h. 59 m. 54 s.	147	264
" tandem.....	2 h. 46 m. 03 s.	6 h. 57 m. 32 s.	.....	298½

Many of these records have been lowered since 1888.† Hence

* From *Outing*, June, 1889.

† From *Outing*, June, 1889.—"On April 20th two members of the Brooklyn Bicycle Club made 101 miles from 5.00 A. M. to 7.40 P. M."

From *Outing*, Sept., 1890.—"On July 9, Arthur Insley of England rode 161 miles on a tricycle in 12 hours breaking the previous road record of 151 miles made by W. C. Goulding last September. He rode from 9.15 A. M. to 9.15 P. M."

"Edward T. McLoughlin, Jr., H. C. W., rode 105½ miles over Jersey roads on August 3d, in 10 hours, 30 minutes."

we may say of bicycles and tricycles as a means of moving infantry rapidly, that nearly everything is as yet in an experimental state, with the probabilities fairly good that they will fulfill the first object of mounted infantry, so far as small bodies are concerned and that they can be used at times to carry out partially the second object. The use of large bodies of cyclist infantry would no doubt be of value; but the present conditions of warfare on this side of the Atlantic, and the topographical features of our country, render such a scheme impracticable.*

CARS.

Since cars can be used for all arms of the service equally well, no special reference need be made here to their great value in moving infantry rapidly. We will say, however, that too great dependence must not be placed on this means; for the operations of a campaign may carry us away from the railroads, and we should aim to obtain by other means the greatest possible mobility for our infantry.

THE HORSE.

The true means of locomotion for Mounted Infantry is the horse. By this term we would also include ponies and mules; because the districts where the services of mounted infantry would be required might be such as to enable the work to be better done by the use of the smaller, hardier animal, as instances to be quoted later on will prove. The horse is the only means that fulfills every requirement and offers few disadvantages, and none that cannot be overcome. While not denying the advantages to follow the use of wagons and bicycles upon special occasions when the conditions are favorable, the only means that can be considered as always available is the horse. The force, however, to be considered as efficient, must be mounted from the beginning of the campaign. The men must be proficient as riders, well drilled as infantry, and above all, be well mounted, whether horses or ponies be used. The mounts should be kept in good

From *Outing*, Dec., 1890.—"Ernest C. Rowe of New Haven rode across the continent from New Haven to San Francisco between Aug. 14 and Oct 21."

"Road race—25 miles—time 1 h. 37 m. 33 s."—"Best mile, W. C. Jones (Eng.), time 2.13 3/5."—*Outing*, Jan., 1891—"H. Parsons (Eng.), 60 miles in 2 h. 57 m 58 4/5 seconds."

* For a full description of the English ideas on Cyclist infantry, see Gall's Modern Tactics—Chap. xix., p. 200.

condition, and this necessitates a proper knowledge of the care of horses. Poor mounts are worse than none, and inexperienced riders are absolutely worthless. With poor mounts and inexperienced riders mounted infantry would be unable to keep pace with the cavalry, and would become even less mobile than ordinary infantry. Before considering the organization and training of mounted infantry let us see what has been done in the United States and abroad with mounted infantry.

In the United States.—The history of the United States Army has been that of a practically unceasing war with the Indians. The latter, gradually pressed back by the westward march of civilization, yielded reluctantly and after many contests of arms the successive lines of the Alleghenies, the Mississippi, and the Missouri. As civilization encroached upon the Indians of the great plains—the mounted warriors—the need of mounted troops became more and more felt. Most of the latter had been, up to 1861, dragoons and cavalry; and we find but one regiment of mounted riflemen. This regiment was organized under the act of Congress of May 19, 1846, and continued until August 3, 1861, when the designation was changed to the 3d Regiment of Cavalry. From that time until the present all of our regular mounted troops, and also the volunteer mounted troops of the late war, were designated as cavalry, although some were armed with the rifle and locally called mounted infantry. As an example of the latter, we quote the following from the *Century* War Series*:

"Wilder's brigade, with Colonel T. J. Harrison's 39th Indiana Mounted Infantry Regiment which was ordered to report to Colonel Wilder about 9 o'clock A. M., of the 20th of September, was stationed on a hill about one-third of a mile in the rear of the line of battle—the 39th on the left of the brigade. A few minutes after 11 o'clock A. M., the brigade was ordered to advance across the valley where the ammunition train was stationed, and up the hill to the support of Captain Lilly's battery and to hold the hill at all hazards until the train was got out of the way. My company "A," 39th Indiana, was in advance, and on reaching the brow of the hill, Major Evans gave the commands: '39th Indiana. On left into line. Fire at will.' At a distance of less than fifty yards six solid lines of grey were coming with their hats down,

* *Century* War Series—Vol. III., pp. 658–659, foot note to "Article on Chickamauga."

their bayonets at a charge, and the old familiar rebel yell. Our first volley did not check their advance, but as volley after volley from our Spencer rifles followed with scarce a second intermission, and regiment after regiment came on left into line on our right, and poured the same steady, deadly, fire into their fast thinning ranks, they broke and fled. Colonel Wilder and Colonel Harrison rode along the lines directing that if they charged again, no shot must be fired until the word of command was given. In a few moments those lines of grey once more emerged from the sheltering timber on the opposite side of the field, and steadily, as if on parade, they advanced to the charge till the line had reached to the point at which they broke before, when the command 'Fire' was given, and again they broke and fled in wild confusion. Three times more did those brave men advance at a charge, and each time they were hurled back. * * * * We then received orders to move off, remount, and guard the ammunition train to Chattanooga, which we did successfully."

Our regular cavalry at the outbreak of the Civil War were cavalry in every sense of the term. They constituted the model for the cavalry upon both sides during that war. They had not only mastered the art of using the *arme blanche*, like the European cavalry; but, by long experience, they had acquired a facility and such a skill in the use of the carbine, dismounted, that it was to have a deciding effect upon the fortunes of the war, and that was to make a lasting impression, or should have done so, upon the cavalry of all nations. Of the volunteer mounted regiments we can say that, although designated as cavalry from the date of their organization, they were in fact mounted infantry, and remained such during the earlier years of the war; but, towards the close of the war, in 1864 and 1865, most of these regiments, and especially those with educated and trained leaders, became the truest and best of cavalry, as ready for a fight with sabre and pistol mounted against the enemy's cavalry as for a dismounted fight, if necessary, with dismounted troops.

The close of the Civil War witnessed the disbanding of our large force of cavalry; and since that time (1866) our mounted troops have consisted of ten regiments of cavalry—between six and seven thousand men. This force has been, and is armed with the carbine, revolver and sabre. No regiment of mounted riflemen has been organized; but the exigencies of the service have,

time and again, necessitated the mounting of the infantry upon ponies or horses, in order to overtake the well-mounted Indians. One of the most notable instances will be given. We quote the following from the official records*:

"From those who had surrendered (April 22, 1877), Colonel Miles learned that a band of renegades, chiefly Minneconjous, under 'Lame Deer,' had determined not to yield; had broken off from those who surrendered at Tongue River, and had moved westward. This was about April 22, and as soon as the necessary forage could be obtained, on May 1st, Colonel Miles with a force consisting of Troops "F," "G," "H" and "L," 2d Cavalry, Companies "E" and "H," 5th Infantry, and "E," "F," "G" and "H," 22d Infantry, started up Tongue River. At a point sixty-three miles from its mouth, they cut loose from the wagons, struck across to and moved up the Rosebud; and, after a very hard march with scarcely a halt during two nights and one day, the command surprised 'Lame Deer's' band on May 7th, near the mouth of Muddy Creek, an affluent of the Rosebud. The village was charged in fine style and the Indian herd of animals cut off and secured. The Indians were called on to surrender. 'Lame Deer' and 'Iron Star,' his head warrior, appeared desirous of doing so, but after shaking hands with some of the officers, the Indians, either meditating treachery or fearing it, again began firing. This ended peace-making and the fight was resumed, the hostiles being driven in a running fight eight miles across the broken country to the Rosebud. Fourteen Indians were killed, including 'Lame Deer' and 'Iron Star,' and four hundred and fifty horses, mules and ponies, and the entire Indian camp outfit were captured, including fifty-one lodges well stored with supplies. * * * The Indians who escaped subsequently moved eastward to the Little Missouri and the command returned to the cantonment, where four companies 'B,' 'F,' 'G' and 'I,' 5th Infantry were mounted upon the Indian ponies."

† Captain (now Lt.-Col.) Simon Snyder was placed in command of the mounted battalion, and at once formulated a simple drill assimilated to the cavalry, but containing nothing but the simplest movements. The first three weeks' training was of a character

* From "Record of Engagements with Hostile Indians with Division of the Missouri from 1868 to 1882."—p. 77–78.

† I am indebted to 1st Lieut. C. B. Thompson, 5th Infantry, who served with this battalion, for the information in regard to its training.

to accustom the ponies to be handled by white men; to get the soldiers accustomed to their ponies, and each pony to its rider. This was necessary, owing to the peculiar trait of the Indian pony to recognize no one but its owner. Meanwhile drills went on. Old soldiers who, by reason of age or partial disability were not able to ride, were transferred to other companies of the regiment, and the strength of the mounted companies was increased to fifty men each. The ponies were kept close to the skirmish line during drill to accustom them to the firing—at first being led by the lariat, but after a few drills following their owners if the lariat were allowed to drag on the ground. Then followed the training of the horses to allow the rifle to be fired from their backs. This was successfully accomplished to the right, left, and even to the front, which latter could not be carried out at all by the cavalry with their short carbines over their larger horses. During all the drills the men were allowed to carry their rifles in any safe position, in order that the best position might be finally selected and adopted. This was found to be across the horse in front of the saddle and attached to it by means of a wide leather band with a loop into which the rifle was inserted; the two ends of the band being fastened together, a large hole was made through the ends, and this was placed over the pommel or horn of the saddle. As the American saddles issued were generally too large for the ponies, some use was made of the captured Indian saddles. In going through timber, underbrush, or over rough country, the rifle was generally carried vertically, with the butt resting on the hooded boot of the stirrup. The ponies were of more value than horses would have been. They were hardy, accustomed to the country, required little or no grain or other forage except what they were able to pick up by grazing, they did not need the same care and grooming as the larger American horses, and they were able from long experience to make long forced marches without apparent detriment. The first trip of the battalion in the field demonstrated its mobility. Early in June, 1877, it left the cantonment at about 4.30 o'clock P. M. on a Thursday and returned (the next) Sunday night, covering in the meantime a distance of one hundred and twenty-three miles, in spite of the fact that it rained incessantly during forty hours of the time. The battalion was in the field almost continuously from June until December (1877), covering in its scouting and reconnoitring about two thousand five hundred miles. Its principal fight was at the battle of

Bear Paw Mountain on September 30, 1877. The action is thus described *:

"On September 30th, at seven o'clock in the morning, after a march of two hundred and sixty-seven miles, Colonel (now Maj. Gen.) Miles' command was upon the trail of the Nez Percés, and their village was reported only a few miles away. It was located within the curve of a crescent-shaped cut bank in the valley of Snake Creek, and this, with the position of some warriors in ravines leading into the valley, rendered it impossible for his scouts to determine the full size and strength of the camp. The whole column, however, advanced at a rapid gait, the leading battalion of the 2d Cavalry being sent to make a slight detour, attack in rear, and cut off and secure the herd. This was done in gallant style, the battalion in a running fight capturing upwards of eight hundred ponies. The battalions of the 7th Cavalry and the 5th Infantry charged, mounted, directly upon the village. The attack was met by a desperate resistance, and every advance was stubbornly contested by the Indians, but with courageous persistence, fighting dismounted, the troops secured command of the whole Indian position excepting the beds of some of the ravines in which some of the warriors were posted. * * * * The Indian herd having been captured, the eventual escape of the Indians became almost impossible. * * * * The Indians surrendered four days later."

The mounted battalion of the 5th Infantry continued to serve as such, doing much valuable service, until 1881, when, there being no further immediate necessity for its use, it was dismounted.

Fractions of various infantry regiments have, from time to time, been mounted for short periods—generally, to supply a deficiency in the number of available cavalry. A recent instance was the proposed mounting of the 1st, 5th and 7th regiments of Infantry during the Sioux campaign of last winter. The shortness of the campaign, however, prevented the consummation of the plan. A portion of the 1st Infantry was mounted at Pine Ridge upon ponies captured from the hostile Indians. The examples given heretofore show us the American idea of mounted infantry and of its use.

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* From "Record of Engagements with Hostile Indians within the Division of the Missouri from 1868 to 1882."—p. 83–84.

MOUNTED INFANTRY IN EUROPE.

When we come to consider the use of mounted infantry in England and on the Continent, we find that the diverse views in regard to what constitutes the *true* cavalry and what mounted infantry, and the various designations given to mounted soldiers armed with the same weapons in the different countries, naturally cause some perplexity to those of us who are accustomed to think of our own cavalry as the highest type of that arm (as it undoubtedly is); and, furthermore, examples given by various writers upon Mounted Infantry of the use of that arm in European warfare, are quite as often quoted by the advocates of the dismounted action of cavalry. English writers, in particular, allude to our troops as "so-called cavalry." Let us see what are the views of one of our greatest living cavalry leaders*:

"Americans may pride themselves on having learned a lesson and practised its principles twenty-five years since, which the nations of the old world have not learned yet. Why harp on the cavalry of Frederick the Great and Napoleon, when the conditions for its service have so essentially changed? If it is any consolation to the English that their cavalry at Balaklava was not 'so-called cavalry,' they are welcome to all the glory that fact carries with it. Wise men will conclude in time that the duty done by the French cavalry at Woerth, or the German cavalry at Mars-la-Tour, scarcely compensated for the difference of name—better be 'so-called cavalry,' alive and ready for future emergencies, than the shattered fragments which illustrate the Frenchman's remark, 'It is grand, but it is not war.'"

In speaking of cavalry, in referring to various European examples, I shall consider our own as the highest type of modern cavalry.

The wars of 1866 and of 1870–71 afford us but negative examples of the use of mounted infantry; that is, not the use of mounted infantry, but the cases where its use would have been of inestimable value. As, for instance, Lieutenant Wagner, in his recent work on the campaign of Königgrätz, says: "On the 20th of July, 1866, Benedek's army, pushing from Olmütz towards Vienna with a view to anticipating the Prussians at that point, ar-

* Brevet Maj.-Gen. Wesley Merritt, Brig.-Gen. U. S. A., Maj.-Gen. U. S. V., Commanding Cav. Corps, Army of the Potomac, in 1865—in JOURNAL M. S. I. for September, 1889, p. 521.

rived at Tyrnau. The possession of Pressburg was necessary, for if the Prussians should seize that point and occupy it in force, Benedek would be cut off from the capital. Orders had been sent to Tyrnau in advance of the arrival of the army, to hold 1000 country carts in readiness, and by means of this transportation the leading brigade was immediately conveyed to Pressburg, covering a distance of nearly thirty miles in less than a day, and reinforcing the single brigade, which up to that time held Pressburg."

What would have been the result had the Austrian leader possessed a force of true mounted infantry, or of such cavalry as we have? It is true he mounted his infantry upon carts and thereby greatly accelerated their movements; but a strong force of true mounted infantry or cavalry would have thought nothing of covering the thirty miles to Pressburg, and once there they could have held it. Could Benedek have done this with his cavalry? Evidently not.

Lumley says*: "The war of 1866 does not furnish a single instance of the employment of dismounted cavalry, but Jägers (riflemen) were attached to some of the reconnoissances carried out by the Light Cavalry."

The same writer in speaking of the War of 1870–71, says†: "In my opinion the battle of Mars-la-Tour, if compared with Sheridan's movements after the engagement at Five Forks, speaks greatly in favor of the employment of mounted infantry. Although the object in view was obtained in the former battle by the noble sacrifice made by the Prussian cavalry, still, although a cavalry officer, I cannot help admitting the same result would have been obtained at a very much less expenditure of life and money had mounted infantry been employed."

Lumley also quotes the well-known instance at Vibray, where a dozen French *chasseurs d'Afrique* actually stopped a whole Prussian cavalry brigade, and kept them in check for a short time, when a few rifles in the hands of the advanced guard of the brigade could have easily cleared the way. Such examples as the one just quoted need no comment, they speak for themselves.

The War of 1870–71 resulted in the Germans adopting the

* Capt. J. R. Lumley, late 13th Prussian Uhlans and Lonsdale Horse, in the Journal of the Royal United Service Institution on "Mounted Riflemen," reprinted in Ordnance Note, 169, p. 5.

† Same, p. 5 and 6.

carbine for their cavalry; but now, although they are trained to its use, they do not seem to appreciate its value; for the latest tendencies of the German cavalry are towards shock action in large masses, and in their recent manœuvres in Silesia, according to newspaper accounts, they practised their cavalry in charging unshaken lines of infantry.

In regard to the War of 1877–78, Shaw says*:

"In the Russo-Turkish war of 1877, infantry were on several occasions sent to the front in an improvised manner. The Russian dragoons, accustomed to act on foot, and armed with a rifle and bayonet, in more than one instance took infantrymen behind them on their horses and thereby doubled their numbers in the ensuing action on foot. An incident which is related in Greene's 'History of the War,' as occurring at the battle of the Shipka Pass may also be recalled to mind. During the afternoon of August 23d, the Russian position was almost desperate. The Turks in superior numbers were advancing towards the high road to cut their enemy's communications, at a time when the Russians had no reserves left to meet the attack. The movement was the most critical of the campaign, for if the Turkish column reached the high road, and established itself in the rear of the Russians and upon their one line of communications, a disastrous retreat before a largely superior force, or possibly a surrender was inevitable. * * * At this moment (about 4.30 P. M.) appeared in sight the first of the reinforcements, 200 men of the 4th Rifle Brigade, trotting up along the high road on Cossack horses, from Gabrova; with them General Radetsky, commanding the VIII. Corps. These infantry troops and others which followed enabled the Russians to hold to their position."

This is one of the clearest and best examples we have of the proper use of mounted infantry, and shows beyond a doubt the great value of such a force.

Greene says,† in closing his chapter on the Russian Cavalry: "The true use of cavalry in modern warfare was developed in our Civil War, viz.: scouting and reconnaissance; in independent raids against lines of communication and supply; in following up a retreat; and, in doing its *heavy fighting on foot*. Since 1865, there has been nothing new on the subject."

The Russians have been the only Europeans to profit fully by

* Shaw's "Elements of Modern Tactics." Edition of 1890, p. 64.

† Greene's "History of the War between Russia and Turkey, 1877–78." p. 453.

our experience in the Civil War; and we may well ask ourselves the question whether they, by arming a portion of their mounted troops with the rifle, or mounting a portion of their infantry, have not made a more efficient fighting machine than we have at present.

The English in their recent minor wars have made use of small bodies of mounted infantry.

In the Zulu war, in 1879, a small force of two hundred mounted riflemen under Captain Lumley was used with some effect.*

In the campaign in Egypt in 1882† "a small force was organized from volunteers from different regiments, and was actively employed at Alexandria when no regular cavalry was present, and in all the engagements of the campaign from Ismailia to Cairo. At the outset it was composed of one hundred men selected mainly with reference to their skill as marksmen. The other conditions were good conduct and horsemanship. These men were provided with horses and whatever was necessary to their maintenance as a mounted corps, but great exactness of cavalry drill was avoided, and they were strictly kept to the original idea of being mobile sharp-shooters." Their service was hard. Their losses, from the severe fighting and from disease, were large. "Their value was conceded on every hand, and the desirability of such a force in all military operations universally acknowledged. * * * The friends of the troop were very positive in the expression of their belief that the main object of its formation would be lost if permanently organized, and that it would inevitably grow into a cavalry company, peculiarly armed to be sure, but still a cavalry company strictly speaking, the time and thought of the men being deviated from sharp-shooting to precision of mounted manœuvres and over-careful maintenance of horse-trappings."

A small force of mounted infantry was also used in the campaign in the Soudan.

The English, profiting by the experience gained in Egypt, concluded to organize a force of mounted infantry, or rather to train a certain proportion of their infantry in mounted infantry duties. The idea was good. The plan adopted rather bad. The

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* Ordnance Note, No. 169.

† From "British Naval and Military Operations in Egypt" by Bureau of Naval Intelligence (U. S.), pp. 225–226.

latter in substance was as follows*: "Obtaining a small detachment, viz., one-fourth of a company, from a large number of infantry battalions, and then making these units into companies and the companies into regiments."

In spite of the manifest disadvantages of such a plan, Major Hutton says †: "So far as it is possible to judge, the system has answered well in every respect, and it may be unhesitatingly affirmed that by no other system could the same satisfactory standard of efficiency have been obtained in a two months' course of training."

Major Hutton also, in the same article, gives an outline of the "system of drill, discipline and interior economy," and of the "saddlery and equipment" of his mounted infantry battalion; but we can learn little from his system, or from their "Regulations and Field Service Manual for Mounted Infantry" that is not already familiar to us; for our own cavalry seems to have been the source of their leading ideas upon the subject.

The above brief *resumé* of our own experiences and those of European powers in the use of mounted infantry leads us to the important question:—Do we need a force of Mounted Infantry in our own service and, if so, how can it be best attained? Experience has certainly shown the necessity of mounting portions of our infantry regiments during our Indian campaigns. That similar emergencies will arise in the future, to require the mounting of some of our infantry regiments, does not admit of doubt. How, then, can we best meet such emergencies? The causes which have led to the mounting of the infantry may be said to have been:

1st. The absence of a sufficient force of cavalry.

2d. The necessity of rapid movements of the infantry to keep up with the cavalry, and to overtake a well-mounted enemy.

The solution of the first might properly seem to be an increase in the numbers of the cavalry. Such a course would no doubt be a wise one; but the expense of keeping more cavalry regiments mounted seems to be, to our law-makers, an insurmountable objection at present to such an increase. Such being the case, the problem can be solved in two ways:

* Major Hutton on "Mounted Infantry," reprinted in JOURNAL MILITARY SERVICE INSTITUTION, July, 1889.

† Same.

I—BY UTILIZING OUR PRESENT FORCE OF INFANTRY.

Light Infantry Regiments.—Can we not so arrange our infantry regiments, or a certain proportion of them, that they may be easily mounted at short notice, and can we not avoid the usual troubles that take place when an infantry regiment without previous warning is called upon to do mounted duty?

The object can be easily secured. Let every fifth regiment of our regular infantry be designated as light infantry: the organization to remain the same as it is. The personnel of the regiment should be radically changed, however, no matter what particular regiment might be selected for such duty. The officers should be young, trim-built, athletic, fond of all out-door sports, should have a special aptitude and liking for the work, and should not weigh over one hundred and sixty-five pounds. The men selected for the light infantry regiments should be specially enlisted for them. They should come up to the standard required for our cavalry soldiers, and what is more important, should have a knowledge of horses and of how to ride before being enlisted.

One of the chief difficulties encountered in mounting one of our infantry regiments is the fact that all the men in the command have to be mounted, regardless of age, weight, or disability; and the result is, that but little better time can be made when mounted than when on foot. Such disadvantages would be obviated by the light infantry regiments, in which we would have a proper selection of officers and men in the first place, and by the transfer, from time to time, to the other infantry regiments of such officers and men as would be found to be unfit for mounted service by reason of age, weight, or slight disabilities. Recent regulations regarding promotions and transfers of officers would enable such transfers, as suggested, to be easily made.

Such a regiment should be subject to constant training in marching on foot, drilling always as infantry, but having a sufficient number of mounts for, say, two companies. The companies should take turns in using the horses, say, two months a year, for each company. This would be sufficient to teach them the essential principles of bridling, saddling, riding, the necessary movements for manœuvre, and the proper care of their horses. The rest of the year should be devoted to infantry drill, target practice, and minor tactics. Full kits, saddles, bridles, lariats, etc.,—should be provided for each company—to be used during the two months of mounted drill, and for the other ten months

to be kept in good condition in the company storehouse or armory They should be armed with the rifle, and be equipped as infantry; and their uniforms should be the lightest compatible with comfort. The officers should as a rule be selected from the infantry. With cavalry officers the tendency would be towards acquiring too great nicety of manœuvre in mounted drill. They should be taught to regard the horse merely as a means of locomotion, and that all fighting whatever must be done on foot. They should, however, be thoroughly imbued with the idea that the success of any movement will depend primarily upon the good condition and proper usage of their horses.

Such an arrangement of our infantry regiments would in no manner detract from their utility as infantry pure and simple, and would give us at all times a force available for mounted service as soon as sufficient mounts could be provided. I merely give the barest outline of what such a regiment should be, without going too much into details. The value of the light infantry regiments could not be denied; and they would cover just such cases as we have recently seen in the Sioux campaign at South Dakota.

Such seems to be one way of solving the problem.

2—BY UTILIZING THE INDIAN.

Indian Companies in Regiments.—Recent orders authorize the enlistment of two thousand Indians—each regiment of infantry and cavalry, with a few exceptions, serving west of the Mississippi River to have one such company attached to it. The reports of the officers recruiting Indians, indicate thus far but small success, the Indians objecting for various reasons, principally, however, to the term of service (five years); to being separated from their families; and, so far as the infantry regiments are concerned, to serving on foot.

The effort is still looked upon as an experiment. Should it be successful, we shall have a small force with each regiment of infantry of natural born riders, accustomed from childhood to horses; and with the drill and discipline they would soon acquire while serving on foot, they would make the ideal mounted infantry. For trailing, scouting, reconnoitring, and courier duty, we have always found our small force of Indian scouts to be unsurpassed; and there is no reason why the Indian companies, if mounted, should not be fully as proficient in these duties.

Should the present scheme prove to be a failure, due to the

objections made by the Indians, there still remains the alternative of enlistment for a shorter period and for mounted duty in a very similar manner to that now in vogue with the Indian scouts. Such a force of mounted infantry (whether they be assigned with one company to each regiment of infantry and cavalry or be kept intact as separate battalions and regiments) mounted upon their own ponies, and armed with the rifle or carbine according to the arm of service they be assigned to—if in separate regiments then all with the rifle—would furnish a valuable adjunct to either arm, and would be especially valuable to the infantry. There is no need to deal further with this question so far as it pertains to the Indians, for all of us who have had any experience with them recognize their value.

Either of these methods—light infantry or Indian companies—would give us a means of meeting the emergencies of our minor campaigns, and also of meeting the first great need of mounted troops in case of a larger war. But so long as our cavalry fills its proper sphere, and is not insufficient in numbers, there will be no great need for mounted infantry in our minor campaigns.

VOLUNTEER MOUNTED INFANTRY FOR WAR.

General James H. Wilson, one of the distinguished cavalry leaders of the Civil War, says*:

"I still maintain that in future wars there will, or should, be no essential difference in the organization and uses of mounted troops, whether they are called cavalry, dragoons, or mounted infantry. There are certain differences of armament which are more important than any difference of functions, but just to the extent that fire-arms are dispensed with, the uses of mounted troops will become limited and their efficiency impaired. * * * I regard the difference of real function of the various kinds of mounted troops in actual warfare as largely imaginary and fanciful. No matter what they are called they all have to come down to about the same kind of work in the rough and tumble of an active campaign. * * * I shall not go into the details of armament and equipment, but I hold it as essential that all mounted troops should be armed with magazine carbines or rifles whether they have sabres and pistols or do not have them."

* Bvt. Major-Gen. James H. Wilson, U. S. A. Major-Gen. U. S. V. Commanding Cavalry Corps, Military Division Mississippi, 1865, in JOURNAL M. S. I., for September, 1889, p. 522.

General Hamley says: "For seizing a post or a defile before infantry could arrive there, and which cavalry would be incompetent to hold—for rapidly turning a flank—for executing distant enterprises against communications—mounted riflemen seem the inevitable solution of a problem, the conditions of which are, speed of movement, with ability to contend with any kind of force. * * * Its strength should be such as, after providing for the covering of the army on the march in its most extended order, should keep in hand for the day of battle a force which, joined to an equal force of cavalry, should raise the total of those two to the proportion hitherto considered necessary for the cavalry alone. But, indeed, mounted riflemen would be so generally effective, that the only limit to their numbers need be the means of maintaining them." (Hamley's "Operations of War," page 439.)

A proper regard for the duty entrusted to us as officers of the Army should ever impel us to study every detail of our service—to master the minutiæ—to point out the imperfections and to devise better means of obtaining the best results, and to aim constantly to bring our small Regular Army to be a perfect machine, complete in all its manifold parts and capable of fully and ably performing every duty entrusted to its care, or which it may be called upon to perform.* But we have a higher duty—a duty involving the integrity of the country, the welfare of our fellow-citizens, and the honor of the flag. The duty of fully preparing ourselves in everything that pertains to the organization of volunteer levies for war. No step in such work should be left unthought of till war comes. It will be no easy matter to convert thousands of our citizens into soldiers. Experience has shown that it took years to make soldiers of them, however good the material of which they were composed. As for the volunteer infantry, our regular infantry regiments offer such good models that nothing further need be said except of the necessity of knowing the essentials of training—of what to teach and what not. As for the volunteer cavalry, the regular model is equally good, but we all know that it takes time to make a good cavalryman. As for mounted infantry, such excellence in riding is not required, such minutiæ and detail of mounted drill cannot be considered as essential, and but little more time is needed than for infantry

* I think that I have seen in one of our Service journals a paragraph similar to the preceding. Were I able to place it, I would give its author full credit. The hought is valuable, however, and cannot be too often impressed upon our minds.

pure and simple. Their value cannot be denied in the face of the experiences of our Civil War.

As an element, and a powerful one, in our future wars we may count upon mounted infantry. Our cavalrymen may object to it. —Well, call it *cavalry* then, if you will; but give the *essential attributes—a Rifle—a fight on foot*, and *no knowledge of what a mounted charge means.*

The tendency of late years—especially among our younger officers of cavalry—seems to be to think more and more of the shock action of cavalry; and, forgetting, or laying aside, the knowledge gained after four years of constant strife in this country, to follow the teachings of foreign enthusiasts who seem to care more for the romance of war than its realities, and who forget the real effect of the French cavalry charges at Woerth, or of the celebrated Prussian cavalry charge at Mars-la-Tour. To such enthusiasts among us we can only say: *Be American.* Follow the teachings and the experience of our own great leaders. The times may have changed. New inventions may have altered war and changed the means of dealing out death to your enemies; but it is not time yet to lay aside the experience of our great Civil War. Keep your cavalry up to the standard of what it has been. Do not neglect its dismounted action, and keep in mind the fact that in the wars of the future in which we may take part, the mounted troops, excepting the regular cavalry regiments and a very small percentage of volunteers, will have to be mounted infantry and will have to be trained as such.

Let us study, then, the essentials of training such a force. Learn the least possible instruction that it will be necessary to give them before they can be ordered to the front, and then the successive steps necessary to make them more perfect—neglecting nothing that is essential—omitting everything that is for mere show or is useless in the field.

FORMULAS FOR PENETRATION OF ARMOR.*

By LIEUT. L. G. BERRY, 4TH U. S. ARTILLERY.

WHEN a projectile arrives at the surface of an armor plate, there is stored in it a certain amount of work. After impact, work has been expended; 1st, in deforming and heating the projectile; 2d, deforming and heating the armor plate; 3d, in imparting velocity to fragments of the plate and projectile. If the plate has stopped the projectile, the energy of the latter has been wholly expended in these ways, if not, we must add; 4th, the work stored in the projectile after penetration.

It is the object of the projectile maker to make the first quantity a minimum; with the manufacturer of armor, the reverse is the case.

Therefore, in any formula for the penetration of armor, we may assume as the first member the work stored in the projectile at impact, $\frac{w v^2}{2g}$; and as it will be necessary to find the velocity which will give complete perforation only, of the armor plate, we may neglect the fourth sub-division in this discussion. The third is usually small in comparison with the first and second.

The work done on the projectile is very hard to calculate, but for similar projectiles it is usually about the same. We may allow for it by introducing a numerical co-efficient into the formula, which will be a measure of the efficiency of the projectile.

In discussing the work done on the plate, it has been customary to divide the armor into two classes, called respectively hard and soft, the former of which can be destroyed by cracking but cannot be penetrated, the latter allowing a certain amount of penetration, and not cracking so easily.

The first class includes chilled cast-iron and hard steel, and the second wrought-iron and the milder varieties of steel.

A measure of the energy necessary to destroy hard armor is hard to find. It is sometimes given in tons per unit of area, but it

* Artillery School Essay selected for publication in the JOURNAL M. S. I.

may in general terms be stated that a projectile which will perforate soft steel armor, will destroy hard armor of equal thickness. This rule does not hold so well for high velocities as for low ones, and is only approximate at best. It is to wrought-iron and soft steel that the formulas especially relate.

To deduce the normal form of the equation for penetration, we will first assume that, with similar projectiles moving at the same velocity, the penetration is proportional to the calibre. This seems reasonable, and it is worthy of note that the formulas which have given the most satisfactory results, have nearly all embodied this condition. We would then have for the form of our equation $\frac{w\,v^2}{d^2} = \frac{c_a}{c_s} K\,\varphi\left(\frac{t}{d}\right)$, in which

w=weight of projectile in pounds or kilograms,
d=calibre of projectile in inches or centimetres.
v=velocity of projectile in feet or metres.
t=penetration of projectile in inches or centimetres.
c_a=a constant depending on the armor.
c_s=a constant depending on the projectile.
K=a constant.

To determine the form of the function, $\varphi\left(\frac{t}{d}\right)$, for steel armor, we may consider the penetration divided into four stages:

1st. While the projectile is penetrating up to the head of the ogive.

2d. The penetration which the projectile accomplishes subsequent to the first stage, and while it forces the displaced metal to the front.

3d. The penetration subsequent to the second stage, while the displaced metal is forced to the rear without rupture.

4th. When the point of the projectile is near the back of the plate and the metal breaks to the rear, star-shaped cracks radiating from the point of the projectile, and allowing the projectile to complete its perforation.

The first and second cases correspond to the analytical condition of assuming that the plate is infinitely thick, and the third and fourth to the condition that the projectiles shall have started from the interior of an infinitely thick plate. For small values of $\frac{t}{d}$, the fourth is the only stage, the plate being then torn through or punched through and the work done proportional to a power of the quantity $\frac{t}{d}$ near the first.

Examples of formulas for this stage, are Krupp's for wrought-iron, which may be written,—

$$\frac{w v^2}{d^3} = \log^{-1} \; 5.77765 \left(\frac{t}{d}\right)^{\frac{4}{3}}$$

and that of M. Jacob de Marre, Capitain d'artillerie de la marine, for steel, which may be written,—

$$\frac{w v^2}{d^{2.9}} = \log^{-1} \; 6.01868 \left(\frac{t}{d}\right)^{1.4}$$

The softer the metal, the longer these formulas apply. That for wrought-iron, will probably apply to any thickness now in use. That for steel, will give correct results for values of $\frac{t}{d}$ not exceeding unity.

In the other cases, the projectile causes a cold flow of the metal, forcing it to the front and rear of the plate. In the first stage it probably causes the burr so uniformly seen about shot holes in armor plates; and, in the second and third stages, gives rise to the bulges seen in the front and rear of the plate.

In these stages, if we consider the metal as resisting equally throughout its mass, which is probably the case, the energy absorbed would vary as the volumes of the disturbed masses, and these would in their turn vary nearly as the cubes of their altitudes, or nearly as $\left(\frac{t}{d}\right)_3$.

From the above discussion it will be seen that if the formula is placed in a simple monomial form, the exponent of $\left(\frac{t}{d}\right)$ must vary between limits of 1 and 3.

Lieut. E. M. Weaver, 2d Artillery, has proposed a simple formula which seems to fill the conditions very well for steel. It can be written,—

$$\frac{w v^2}{d^3} = 1258.8 \left(28.4 + \frac{t}{d}\right)^3 \frac{t}{d}$$

Graphical methods are of great use in solving these problems. In this case, we may leave the form of the $\varphi \left(\frac{t}{d}\right)$ undetermined, simply plotting the shots. In the graphical solution given the wrought iron curve is obtained from Krupp's formula as sufficiently representing the law for all thicknesses of wrought iron now in use.

The steel curve is constructed as follows: For values of $\frac{t}{d}$ less than 1 the function is $\left(\frac{t}{d}\right)^{1.4}$; for values between 1 and

$1\frac{3}{4}$ the points are obtained by plotting shots; for greater values the curve is simply an ideal one passing through these points, but this latter part of the curve is of little use.

TO USE THE CHART.

Follow the line passing through the weight of the projectile to the line indicating the calibre of the gun, noting the value of c. Find the intersection of the curve marked with this value of c (interpolation can be made by the eye), with the line passing the value of v; thence, at right angles to the last line, to the curve marked "steel" or "iron," thence at right angles until the line marked with the calibre of the gun is reached, thence at right angles to the scale of penetration.

Besides the formulas above mentioned, the following are some of the many that have been proposed for the purpose.

IRON.

Fairbairn's:—one of the first used, $t=\sqrt{\frac{w\,v^2}{2g2240}\,\frac{1}{\pi d}\times\frac{1}{k}}$, in which k is a variable.

Maitland's:—quite generally used in England $t=\frac{v}{608.3}\sqrt{\frac{w}{d}}-.14d.$

Gâvre:— $\frac{w}{d}v^2=3507\,T^2+2265464.\,t^{14}$, in which T is the thickness of oak backing.

Froloff:— $t+1.5=\frac{w\,v}{400\,d^2}$, for armor thicker than 2".5.

This seems to be of slightly different form from the others, but dividing by d and squaring we have,—

$$\left(\frac{t+1.5}{d}\right)^2=\frac{w^2\,v^2}{160000d^6}$$

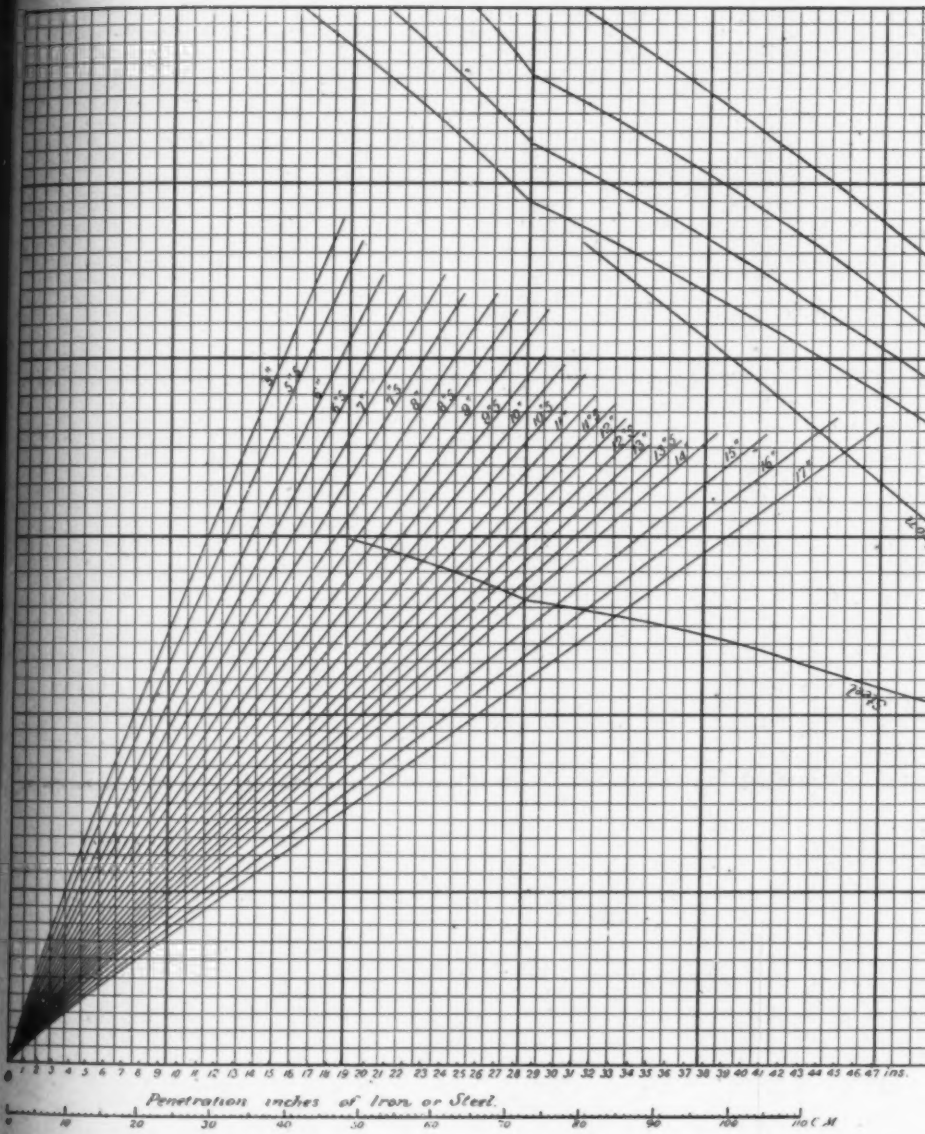
Making $\frac{w}{d^3}=$ constant we have $\frac{w\,v^2}{d^3}=35555\left(\frac{t+1.5}{d}\right)^2$ an equation not differing essentially from many others for the purpose.

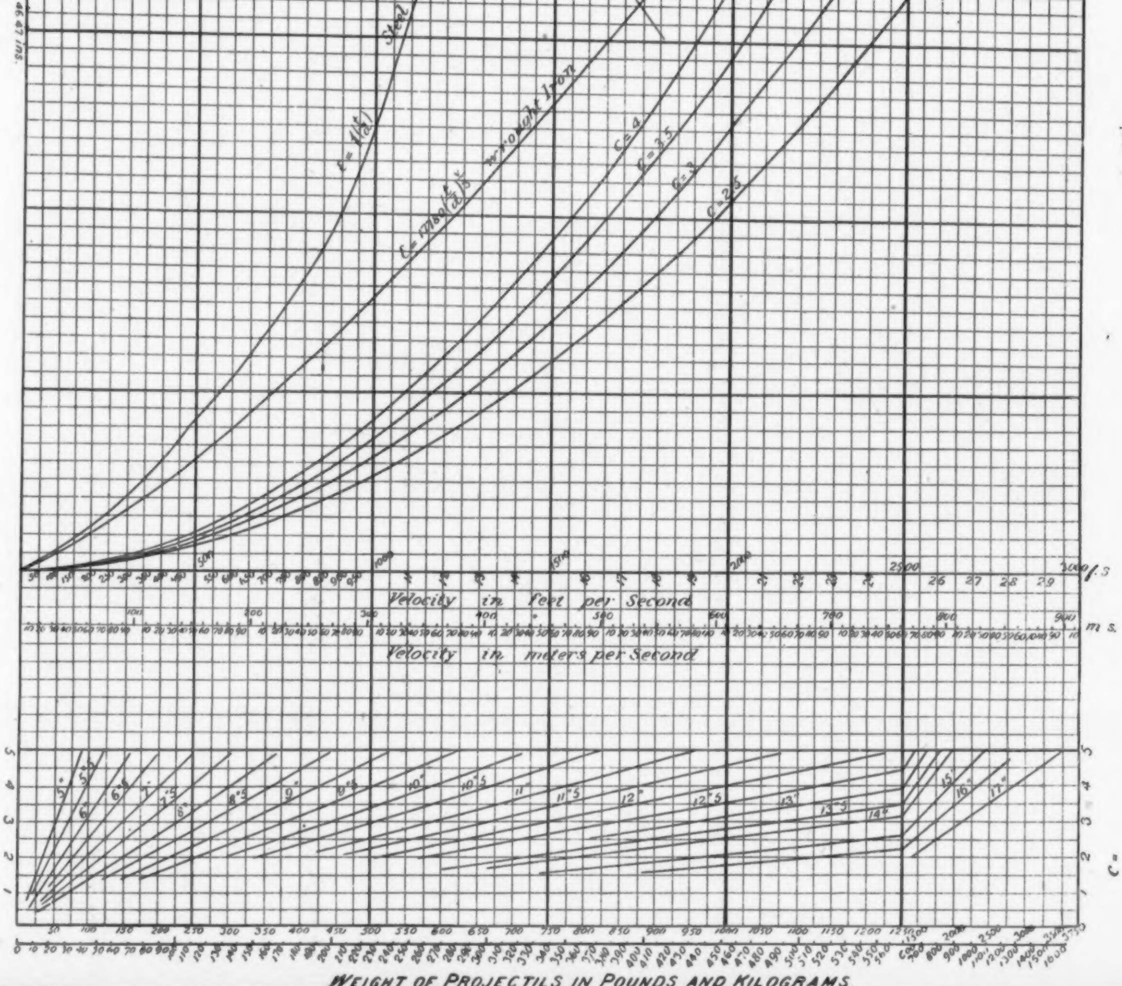
Spezzia Commission:—

$$\frac{w\,v^2}{d}=\log{-1}\ 5.86227\ t^{1.868}$$

Krupp:—

$$\frac{w\,v^2}{d^3}=\log{-1}\ 5.77765\left(\frac{t}{d}\right)^{\frac{1}{2}}$$


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 ins.
Penetration inches of Iron or Steel.
0 10 20 30 40 50 60 70 80 90 100 110 C.M.



46.47 ins.
Steel
wrought Iron
C = 4
C = 3.5
C = 3
C = 2.5
Velocity in feet per Second
Velocity in meters per Second
C =
WEIGHT OF PROJECTILS IN POUNDS AND KILOGRAMS

General Inglis, of the English Army, as modified by Captain Madsen, Danish Army:—

$$\frac{w\,v^2}{d} = \log^{-1}\ 4.49370\ t\ (10\ t + 4\ d)$$

English Admiralty:—

$$\frac{w\,v^2}{d} = \log^{-1}\ 5.98656\ t^{1.445} \quad \text{From } 4'' \text{ to } 10''$$

$$\frac{w\,v^2}{d} = \log^{-1}\ 5.59065\ t^{2.025} \quad \text{From } 10'' \text{ to } 20''$$

Colonel Martin de Brettes:—

$$\frac{w\,v^2}{d^3} = 437500\frac{t}{d} + 161810\frac{t^2}{d^2}$$

Captain de Marre, above mentioned, has proposed the following formulas:—

$t^{.7} = \log^{-1}\ \bar{4}.99066\ \dfrac{w^{\frac{1}{2}}v}{d^{\frac{5}{4}}}$, for steel.

$t^{.6} = \log^{-1}\ \bar{3}.79013\ \dfrac{w^{\frac{1}{2}}v}{d^{\frac{3}{4}}}$, for wood backing.

$t^{.7} = \log^{-1}\ \bar{4}.86572\ \dfrac{w^{\frac{1}{2}}v}{d^{\frac{5}{4}}}$, for thin plates of steel by rapid fire guns.

$t^{.65} = \log^{-1}\ \bar{3}.03838\ \dfrac{w^{\frac{1}{2}}v}{d^{\frac{3}{4}}}$, for wrought-iron.

Perhaps most useful to the artillerist are the simple rules by means of which a quick approximation can be obtained. Such are the following taken from Captain Orde Brown; to which is added a rule for estimating the penetration in oak, taken from the Gâvre formula, by making $\frac{w}{d^2}$ equal .45 and extracting the square root; also rules for estimating the penetration in earth and sand, taken from General Froloff:—

Penetration in	is one calibre for every
Wrought-iron,	1000 feet striking velocity.
Steel,	1500 " " "
Oak,	87 " " "
Packed sand,	60 " " "
Earth, a mixture of sand, clay and vegetable mould free from stone,	40 " " "

COMPILATION OF FACTS RELATING TO HIGH EXPLOSIVES.

By LIEUT.-COL. JOSEPH P. FARLEY, Ordnance Dep't U. S. A.

"It is obvious that the days of black powder are numbered, and as one who has been closely connected with its manufacture in India for the past twelve years, I may be allowed to feel some regret that this should be the case.

"It is impossible to forget what an influence its employment has had on the history of the world, and how, until quite recently it has held its own against every other explosive.

"As has been pointed out by one of its admirers, it possesses a power of adapting itself to purposes of the most vital nature. In mines it blasts without propelling, in a gun it propels without blasting, and in a shell it serves both purposes combined, in a fuse as in fireworks it burns slowly without exploding.

"Its pressure exercised in these numerous operations varies between one ounce more or less to the square inch in a fuse, to 85,000 pounds per square inch in a shell."

THESE views are expressed by Major C. H. Scott, R. A., at the present time and for past years superintendent of the Military Gunpowder Factory in India, and words such as these, from such a source, tempered as they are with pathos, are full of import.

Whilst it cannot be said that explosive compounds have been regularly entered into warfare, or that they have kept pace with the vast strides of science, in the field of electrics, mechanics and chemics, yet smokeless powders have come to be recognized the world over, as factors which must upset preconceived theories, and revolutionize old methods.

As dynamite is dynamite in the common acceptance of the term, whether it be of high or low degree, so likewise smokeless powders are largely explosive gelatines; a question again of *degree* and not of kind, and so *to-day*, we place with impunity a proportion of nitroglycerine and gun-cotton combined, behind our projectile to propel it from the bore of the gun, when but *yesterday* it was a hazard to trust it in the shell even as a bursting charge. If then, starting with explosive gelatine at the head of the list (nitro-

glycerine 95%, gun-cotton 5%), and passing to the foot of the class we find a compound with but an altered ratio of these substances denominated "*smokeless powder*," (nitroglycerine 50%, gun-cotton 50%) it is not to be wondered at, that there should be as many chance combinations between these limits as there are accidents of shade on the painter's palette; and although it is not safe to premise that the doom of black powder is sealed, yet even as we write, it may be that the potent factor, the unknown quantity which enters the problem of national existence, is at the moment determined.

Wolseley, in his paper on Von Moltke, says, that:

"To excel, the general must be ahead of his adversary in tactical knowledge and in his application of modern invention to tactics. * * * He must train his army and prepare it tactically for a warfare to be waged with high explosives, magazine arms, balloons, the electric light and cycles."

Certain it is, that there is no limit to the possibilities of high explosives, but it is well maintained that nothing short of a war, and a protracted one at that, waged by civilized nations, can determine the relative values for the various devices contrived for the destruction of material and the annihilation of men.

The record of the Confederate torpedo service is most brilliant, and stands pre-eminent in the annals of warfare; giving assurance to ourselves, and to all the world a warning, of what can be done by, and what may be expected of, a bold and skillful people.

From Commander Sleeman, late of the Ottoman Navy, we have this passing tribute:

"It is a historical fact that the wonderful ingenuity displayed by the Confederates in devising and constructing self-acting and controlled submarine mines and surface spar torpedo boats, was one, if not the principal cause of the protracted nature of the terrible struggle between the Northern and Southern States of America."

This he instances in disparagement of the Powers engaged in the conflicts of later years, referring as he does, to the lack of efficiency displayed in the torpedo service during the campaigns of 1870 and 1877.

Of the implements themselves then employed he speaks, as being far superior to the crude and in many instances hastily extemporized devices used by the Confederates.

To the moral power of the submarine mine he attaches great weight and to it he attributes the delay on the part of the Brazilians in not having brought to a more speedy close the war with

the Paraguayans, claiming as well that but for this *silent force* the Austrian ports would not have been left unmolested by the ships of Italy in 1866. That but for this force the splendid navy of France would not have proved so utterly valueless to the French in their great need in 1870, and to this dread of the torpedo he also ascribes the incapacity of the Turks to make full use of their superiority on the Danube and in the Black Sea in 1877.

We cannot enter upon a discussion of the subject of high explosions and ignore the valuable formulas framed by Abbot after years of patent labor and research. They are therefore introduced and briefly translated, not so much for the benefit of those whose attention has been specially directed to this subject, as to indicate to the general reader the methods pursued by the highest authority on submarine mines and torpedoes.

Although the potential energy of explosive mixtures (gunpowders) is not converted to kinetic energy so completely as is the case with explosive compounds (high explosives), yet notwithstanding, Gen. Abbot of the U. S. Engineer Corps, has determined from explosions under ice, comparing the areas of rupture, that the relative efficiency of powders, such as mammoth, cannon, mortar, musket, sporting and the like, vary in efficiency *inversely as the size of the grain.*

The mechanical work done in sub-aqueous explosions, in shortening lead cylinders arranged in housings set in rings around the charge, is determined from the kinetic energy due to the blow of a pendulum bob, which produces a like effect on similar cylinders.

The product of the mean pressures multiplied by the path, which in this case is the degree of compression of the cylinder, being equal to the kinetic energy, the quotient resulting from a division of the experimentally determined energy by this path, gives the mean pressure sought.

The formula framed by Abbot to express the most general case of sub-aqueous explosion takes the form

$$W = \frac{K\,(a + E)^t\, S^y\, C^x}{(D + A)^q\, R^z}$$

which for explosive compounds, making the proper substitutions for K, t, y, x, q and z determined by experiment, reduces to

$$W = \frac{0.21\,(a + E)\,C}{(D + 0.01)^{2.1}}$$

from which results

$$P = \sqrt[3]{\left(\frac{6636\,(a + E)C}{(D + 00.1)^{2.1}}\right)^2}$$

and for explosive mixtures

$$P = \sqrt[3]{\left(\frac{MS^{\frac{1}{16}}\,C^{1.94}}{(D+1)^2\,\sqrt{R}}\right)^2}$$

In these formula

W—The mechanical work done by a submarine explosion, expressed in foot pounds per square inch of surface exposed to shock.

P—Intensity of action or sudden pressure in pounds per square inch of above surface exposed.

C—Weight of charge in pounds.

D—Distance in feet from centre of charge to the above surface.

S—Submersion of centre of charge in feet.

R—Radius of sphere equal in volume to the explosive fired.

a—Angle in degrees at centre of charge, between the vertical downwards, and line of direction of the blow examined.

E—Value to be found by trial for each explosive compound.

M—Ditto for each explosive mixture.

In framing this formula it has been assumed that the energy developed by detonation of high explosives *varies directly* as C, or to some power of C, as C^x, when, as in the case of a mixture, some portion of the charge is driven off unexploded.

With a perfectly incompressible fluid the total energy transmitted should be *inversely* proportional to the square of the distance, but with water which is not perfectly incompressible this distance term should have something greater than 2 (but very near it) as its exponent, this is expressed by "q."

Also for the reason that infinite energy cannot result at zero distance, the function for distance should take some form as $(D + A)^q$ in which A is a small constant depending for its value upon the energy developed at the centre of the charge. This function then enters the formula for W, in the denominator.

The effect of increasing S, is to increase the fluid pressure around C, and therefore to increase the resistance to the formation of the globe of gas, when C is exploded.

A function S^y in the numerator satisfies this condition.

Again R — o, C — o ∴ R^z placed in the denominator fulfills the needful conditions for that quantity.

It has been shown experimentally that the forces developed by a sub-aqueous explosion indicate that the normal line of maximum intensity will be directed downward.

A function of the form $(a + E)$ in the numerator will fulfill these conditions.

The value of E, determined experimentally for each compound taking "a" as 90°, that is, the action as horizontal, is given by Bucknill:

TABLE XVIII—"BUCKNILL'S SUBMARINE MINES."

Explosives.	Intensity of action under water.	Value for E.
Dynamite,	100	186*
Gun-Cotton,	87	135*A
Gun-Cotton,	100	E
Dualin,	111	232
Lithofracteur or Rendrock,	94	160
Giant powder,	83	120
Vulcan powder,	82	114
Mica powder,	83	119
Nitroglycerine,	81	111
Hercules powder,	106	211
Electric powder,	69	67
Designolle powder,	68	65
Brugere or picric powder,	80	110
Tonite,	85	126
Explosive gelatine (1881)	117	259*
Blasting gelatine (1884)	142	375*
Atlas powder, (A)	100	186
Atlas powder, (B)	99	183
Judson powder, (5)	78	100
Judson powder, (3 F)	62	45
Judson powder, (C. M.)	44	
Rackarock,	88	140
Forcite gelatine,	133	333*
Gelatine dynamite, (No. 1)	123	254
Gelatine dynamite, (No. 2)	?	?
Gelignite,	102	192
Roburite,	?	?

Remarks.—(A) Abbot. (E) English experiments.
Those marked with a * are specially applicable for submarine work.

Referring to the values for the variable constant E, it is noticeable that nitroglycerine pure and simple, ordinarily more effective than dynamite No. 1 with its 25% of inert silica, ranges *below it* in sub-aqueous explosions. This is due to the fact that as water is slightly compressible, and a minute fraction of time is required in order to develop the full effect of an explosion under water, this interval is gained by the less rapid action of the dynamite.

From exhaustive experiments with submarine mines, Abbot has determined that "a mean pressure instantly applied" of 6500 pounds per square inch, on the outer skin of battle ships of the *Monarch* and *Hercules* type (8000 to 9000 tons displacement), will rupture and sink the vessel.

Bucknill of the Royal Engineers also claims, what amounts to the same thing, that a maximum of 12,000 pounds per square inch of all the pressures, from zero to maximum and return to zero, is required to accomplish a like result. Should, however, this latter pressure be considered in the light of a mean pressure instantly applied, we would then most assuredly be afforded a factor of allowance quite ample for operations against the new marine constructions provided with treble bottoms and intermediate storage for coal.

Abbot's formula $R = \sqrt[2.1]{\frac{(a + E)\,C}{8}}$ is, however, so constructed that its denominator (8) may be increased or diminished in a ratio dependent upon the type of vessel to be destroyed.

The targets used in the experiments referred to, consisted of caissons of plate iron, the plates being $\frac{3}{4}$ inch thick on the sides and bottom, and $\frac{1}{2}$ inch thick on deck; the distance between deck and bottom being three feet, and the whole substantially braced with angle irons and twenty or more intercostal plates, dividing the target into as many chambers or compartments. When such targets were anchored fast they represented the resistance of vessels of the type mentioned, but when free to move under the impulse of explosion, a loss of 90% in effect was recorded, nor was this loss compensated in any commensurate degree by increase of explosive charge.

It was found that a mean pressure instantaneously applied of 140,000 lbs. per square inch, results from the sub-aqueous explosion of 500 lbs. of dynamite No. 1 at five feet distance, and that at ten times this distance the mean pressure fell off to 6500

lbs. per sq. inch, from which it may be seen how intensely local in effect is the explosion of such compound.

However, the racking effect of large charges at comparatively great distances is not to be underestimated, and in spite of the rapidly reducing pressure [per sq. inch] with increase of distance the total energy is not proportionately reduced, since these lesser pressures are much more evenly distributed and over considerably larger areas.

As a compromise then between the local effect of small charges at short distances, and the racking effect of large charges at greater distances, it has been maintained that submarine mines charged with moderate quantities of blasting gelatine, at short intervals, would constitute a more effective harbor defense than if larger charges are employed at greater intervals.

As a measure of the comparative effectiveness of any selected high explosive, such as blasting gelatine for distances ranging between 5 and 40 feet, Commander Barber gives the charges reckoned by Abbot and Bucknill as follows:

	Abbot.	Bucknill.
At 5 feet	4 lbs.	23
" 10 "	17 "	75
" 20 "	67 "	177
" 30 "	160 "	274
" 40 "	311 "	369

It will be observed that at practical working distances, say 30 to 40 feet, the estimates of Abbot and Bucknill do not materially differ, and following the ratio expressed above at 50 feet they should be about the same, whilst beyond that range Abbot's charges are known to be in excess of Bucknill's.

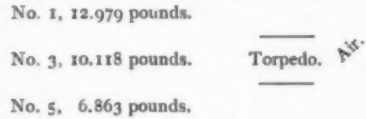
Since the differences in the estimates within limits of zero and 50 feet decrease with the distance, (that is as the blow assimilates more nearly a pressure) we find here an exact accord with experiments heretofore made for the purpose of comparing the effects of dynamite No. 1, with that of gunpowder, in which latter case 100 lbs. of dynamite No. 1 at 16′. 3 [estimated horizontally] produce the same effect as 100 lbs. of gunpowder at 3′. 3 feet, whereas 500 lbs. of the former at 35′ has no more effect than the same charge of the latter at 19′.3; the ratio of effect diminishing from 5 to 2, with the assimilation of blow to pressure.

With reference to the matter of air spacing in the torpedo cases it has been demonstrated that with explosive mixtures such

spacing is directive, but when explosive compounds are employed as the case crumbles instantly, no benefit can result from air spacing with this latter class.

When, however, air spacing can be utilized, the stronger the case the more appreciable the influence, and although advantage may result from strengthening the case or envelope in directing the force, the energy consumed in rupturing the envelope must be considered. This is so appreciable that with high explosives it is deemed advisable to use rubber bags or the thinnest possible envelopes for sub-aqueous mines charged with such explosives.

Abbot cites an instance where, with a torpedo case charged with powder the air spacing was quite potent, but omitting all



other considerations he finds that the proper charges of compounds (now in general use) for destructive horizontal ranges estimated from the point of burst to be as follows:

Charge lb.	Sporting Powder feet.	Gun-Cotton feet.	Dynamite No. 1 feet.	Blasting Gelatine feet.
500	19.5	31.7	35.	39.1
200	7.4	20.5	22.6	25.3
100	3.3	14.7	16.3	18.2

For what follows relating to torpedoes and bursting charges for shell, we are largely indebted to Commander Barber, U. S. Navy, many facts being derived from his interesting lecture before the Franklin Institute, and to Lieutenant Bush* of the Artillery we are indebted for valuable hints and suggestions.

Harbor defense mines are classified as "buoyant" or "ground." The buoyant are usually spherical and contain 400 to 500 lbs. of high explosives. This is double the quantity suggested by Abbot, who advocates increase in the number and reduction in the charges of the mines.

It is claimed for the buoyant torpedo that it possesses the advantage of either striking the ship's bottom or of being in close proximity thereto when fired, but this advantage is qualified by the difficulties of management in a tide way, and its easy removal by the enemy.

Ground mines may be of any size, cannot be found by drag-

* Author of "Development of Submarine Mines and Torpedoes."

ging, but are of little value in water of much greater depth than 40 feet.

In placing the mines, regard must be had to the detonating and collapsing influence of adjacent mines.

The buoyant class charged with 500 lbs. of blasting gelatine should be placed at intervals of 450 feet, and those charged with 500 lbs of gun-cotton should have a spacing of not more than 320 feet.

Ground mines charged with 600 lbs. of gun-cotton should have a spacing of 180 feet, and those charged with 600 lbs of blasting gelatine, 230 feet.

Remaining torpedoes are classed as submarine projectiles, submarine rockets, and locomotive torpedoes, the latter consisting of the auto-mobile and the controllable.

All of the submarine projectiles and rockets may be regarded as in the experimental stage, and of the locomotive and auto-mobile class the Whitehead–Schwartzkoptt and Howell are most prominent. The first two are propelled by compressed air operating an engine within the torpedo, and the last by stored up energy in a fly wheel which operates the propeller shaft in the torpedo itself, the gyroscopic principle in its construction preventing deflection from its path. A force which would ordinarily tend to deflect the torpedo, simply develops rotation around an axis at right angles to the axis of its fly wheel. This wheel is spun to 10,000 rotations per minute before the torpedo is launched, storing a half million foot pounds in the torpedo before it leaves the ship's side.

All of these torpedoes are cigar shaped, 10 to 18 feet long, 1½ to 2 feet in diameter, carrying a charge ranging between 75 and 250 lbs. of high explosives, and with a velocity of 25 to 30 knots per hour for a distance of 400 yards.

Of the controllable torpedoes, we have the Patrick, the Sims or Sims-Edison and the Brennan, 40′ long, 2′ in diameter, and charged with 400 lbs. more or less of high explosives.

The first two are kept at proper distance below the surface by floats, and the last by a diving rudder similar to that provided in the Whitehead.

The Patrick or Patrick-Lay is driven by carbonic acid gas stored in condensed or liquid form, and this expanding into gas drives its engine. The torpedo is steered or guided by electric wires from the shore, and its progress noted by floats.

The Sims or Sims-Edison is driven by electricity from a dynamo on the shore, through a cable, to an electric engine in the torpedo.

The Brennan is driven and controlled by two steel wires, unwound from bobbins on the propeller shaft, by means of a winding engine on shore. The torpedo is thus thrust through the water by a force which is due to the difference between the retarding strain on the wires, and the forward thrust of the propeller, an apparent paradox, since the harder it is pulled back, the faster it goes.

The speed of these torpedoes is about 19 to 20 knots, and the effective range between 1000 and 3000 yards, depending upon length of cable and means for observation.

The explosive compounds used in these torpedoes should fulfill many conditions, since with a shattering effect, they must yet be insensible to shock, plastic, safe to manipulate, permitting an easy insertion of fuse, and be stable in natural temperature in wet localities.

Blasting gelatine, dynamite, or gun-cotton satisfy many, but not all of these requirements, and are very destructive in war fare, whilst for engineering purposes they are simply invaluable; small charges of these compounds with even "low orders" of explosion, (employing the blaster's fuse and fulminate cap, or when fired by the electric fuse), work great destruction of material and save much time, labor and expense.

The question of introducing high explosives in the shape of bursting charges for shells, is one that has engaged and is now engaging the attention of the civilized world, and on the success or failure of these efforts the fate of the present system of warfare depends. The hurling of huge masses of high explosives through the air, and the bursting of the envelope with a degree of certainty at the right time and place, suggests a horrible nightmare to the defense, and grave misgivings to those who are to provide for the safe keeping and handling of explosive compounds. The arguments of the timid and conservative have, however, but little force as we pass from the experimental stage to the arena of war, where men court danger, and gauge triumphs by the risks incurred and results accomplished. During our civil strife this was fairly demonstrated by the Confederates, in their torpedo service.

Whilst it is quite difficult to estimate or measure the force of

explosions under water, it is much more difficult to determine effects in the air, especially under similar conditions to those of actual service; since the force developed by large quantities of an explosive cannot be controlled and measured, and results obtained from small quantities are extremely irregular and totally unreliable.

Berthelot, the head of the French Government Commission on Explosives, calculated the volume of gas produced, heat developed, etc., and presented a method of ascertaining the *specific pressure* of any new explosive that may be brought forward.

The following is the table of these specific pressures, as given by Commander Barber:

Powder,	1
Dynamite No. 1,	13
Gun-cotton,	14
Nitroglycerine,	16
Blasting gelatine,	17

The practical results obtained by Berthelot, Chalon, Roux, Sarrau and others were not reliable or consistent; the method pursued being simply to measure the effects of small charges in confined chambers.

Considering, however, the theoretical estimates and practical tests, it is fair to presume that dynamite No. 1 and gun-cotton are very near to each other in point of effectiveness, and that all nitroglycerine compounds are reduced in potent energy by adding other compounds or ingredients.

The following may be accepted as the ratio of values, as near as can be obtained from computation and experiment combined, for the bursting charges of all envelopes, or projectiles to be exploded in air on impact:

Powder,	1
Gun-Cotton and Dynamite,	10 to 16
Nitroglycerine,	13 to 15
Blasting Gelatine,	15 to 17

Attention has been directed to the subject of high explosives for shell charges for the past thirty years, and with the result that when dynamite is used it must be of such a low order, and the nitroglycerine must be in such small quantity in the compound, that its effects are no better than those following the employment of gunpowder,

A large proportion of nitroglycerine in the dynamite, invariably bursts the gun.

Dry gun-cotton was used in 1864 in small quantities for shell charges but frequently burst the guns from which the shell was fired. A few years since, gun-cotton soaked in paraffine was fired with safety when the charge did not exceed 5 or 6 per cent. of the weight of the shell, but it was then found that it broke the shell into too small fragments to be effective, and on the battle-field the absence of smoke at the point of burst prevented the rectification of aim.

For armor-piercing shell, the projectiles must be of forged steel, with thick walls, and hence the capacity for bursting charge is reduced to 25 per cent. of that provided in common shell. In consequence of the resistance of such shell the plug is blown out of the filling hole, and in passing through armor plate the heat is so great as to prematurely ignite the charge, and produce an explosion of a "low order."

If, however, an explosion can be delayed until the armor is penetrated and this should be of a "first order" *due to the detonator alone*, the problem which has engaged attention for many years will then be solved.

Wet gun-cotton has been found to be sluggish enough for use in shells to be fired from gunpowder guns, but this demands increased power and sensitiveness in the fulminate of mercury fuse, and such fuse is itself apt to explode from the shock of discharge in the gun.

The Germans and Italians it is said claim to have successfully penetrated 5 inches of armor, with shell loaded with gun-cotton, and both the explosive and fuse worked well, but English authorities we are informed dispute this claim.

During the past year [1890] the Austrians claim to have succeeded with Ecrasite, supposed to be blasting gelatine combined with sulphate or hydrochlorate of ammonia, and said to be one and one-half times as powerful as dynamite.

Of the thousands of accounts, concerning the successful use of high explosives in shell, ninety per cent. at least are totally unreliable, being generally of the nature of a prospectus for inventors. Many compounds appear and disappear because of a lack of keeping qualities, through absorbing or evaporating moisture; or else, chemical action renders them dangerously sensitive or completely inert, whilst mechanical separation results, due to

difference in specific gravity of the ingredients, as with dynamite, from which the nitroglycerine exudes.

The capacities for the bursting charges of common shell used in the U. S. Navy, as given by Commander Barber, are as follows:

In the 6″, 6 lbs.—	(weight	of	shell	unloaded) 100 lbs.
In the 8″, 14½ lbs.	"	"	"	250 lbs.
In the 10″, 27 lbs.	"	"	"	500 lbs.
In the 12″, 45 lbs.	"	"	"	850 lbs.

In the armor-piercing shell the

6 lbs.	reduces to	1½ lbs.
14 lbs.	" "	3 lbs.
27 lbs.	" "	5½ lbs.
45 lbs.	" "	11 lbs.

Attempts have been made in gunpowder guns to utilize the devastating force of high explosives in large charges, by employing thin envelopes, and subjecting the projectiles to a shock of discharge no greater than that which produces an initial velocity of say about 800 f. s.

Discs of steel 3 feet in diameter and 1″ thick have been drawn out into cases 8½ inches in diameter and 20 to 24 inches long, having a thickness of 0″.4 of an inch. Such cases contain 42 to 57 lbs. of gun-cotton which is soaked in paraffine, and the ends are closed by discs securely screwed into place. Such projectiles have been fired from 8″.5 mortars using gunpowder, and the same thing has been attempted with 11″.2 calibre mortars, and charges as high as 110 lbs. have been fired.

A crater 16 feet in diameter at the top and 8 feet deep, or 22 cubic yards of earth, has been removed or thrown out by 57 lbs. of gun-cotton exploded on the surface of the ground.

The French use mélenite, which is a compound of picric acid [action of nitric acid on coal tar] with gun-cotton and gum arabic, and lately cresilite has been used, the latter being also a constituent of coal tar (nitro cresol).

The destructive energy of this mélenite is said to be three times as strong as gunpowder, but this largely depends upon the employment of a powerful exploder.

It is stated [*Engineering*, London] that the French and Germans have adopted high explosives for bursting charges of common shell for field artillery. The French shell [steel], four calibres in length, is filled with cresilite and mélenite.

A special wagon is provided for carrying 75 of these shell for each battery of six guns, they being intended to destroy earthworks, walls, etc.

The Germans use wet gun-cotton as a shell charge, and employ these projectiles against animate objects, particularly in endeavoring to search behind breastworks or parapets, since very great protection is offered by such shelter against the flat trajectories of modern field artillery; and it is thought that these positions can best be reached by taking advantage of the enormous local power of a high explosive, which, overcoming the velocity of the projectile at the moment of burst, distributes the splinters of the projectile in all directions.

As German systems are founded upon experiment, the inference is, that the burst can be timed with accuracy, otherwise we should be incredulous on this subject.

The disadvantage of the detonation of gun-cotton is this, that being unattended by smoke, observation of effect and correction of aim cannot be made. From this it is seen, "that the French seek to destroy cover by the use of flying mines, and the Germans endeavor to render such cover useless, by searching behind them."

Neither the French nor Germans propose to use the high explosives against troops in the open, since the shell are broken into such small fragments that they lose effectiveness even at fifty yards from point of burst.

In the six-inch gun (French), the shell has a bursting charge of about 23 lbs. of mélenite; and it is said that in some guns shell charged with seventy pounds of mélenite have been repeatedly and safely fired with an initial velocity of 1300 feet per second.

Ecrasite, lately adopted in Austria, as before stated, is supposed to be a composition of blasting gelatine treated with the sulphate or hydrochlorate of ammonia, and whilst it is more powerful than dynamite, and is said to be as safe to handle as mélenite, it has, when used as a shell charge, penetrated a depth of eight inches of iron without exploding. Extralite, a Swedish compound, is also said to be perfectly safe to handle, being exploded only by special means. It is believed to be a picric acid compound. Experiments with emmensite and bellite are being made in this country at the present time; both of these compounds have picric acid as their principal element.

Smokeless powder appears to be coming into general use, and on this important subject we can do no better than quote in full the views of Capt. S. E. Blunt of the Ordnance Department, now a member of the Magazine Gun Board :

" The trials in this country of smokeless powders for small arms have been principally conducted at the National Armory, Springfield. During the past fifteen months, as many reports have been submitted to the Ordnance Office ; the varieties tried being different forms of Maxim, made in England, the Nobel and Walsrode of Germany, the B. N. of France, the Wetterin of Belgium, a modification of the Wetterin from the Du Ponts of Wilmington, a powder from W. E. Houghton of North Adams, Mass., and one from the Ordnance Department of the U. S. Navy. In addition to these, many preliminary tests for the benefit of the inventors in the earlier stages of their work with other powders have also been conducted.

" The experience gained in these trials suggests the necessity, to even a greater degree than with ordinary gunpowder, of an absence of dust, and of a uniformity in the size and proportion of the grain. The degree of softness of the grain also appears to have a marked effect upon the results.

" The powders being nearly all converted into gas, only about 60% by weight of the former charge, can now be employed, this amount, however, gives a vastly augmented chamber pressure, but a corresponding increase in velocity. This can be best illustrated by reference to the new cartridge for the proposed cal. 30 rifle. The shell will hold but 55 grains of black powder, with which a velocity of 1400 ft. and a chamber pressure of 35,000 lbs. is obtained (the shell being full, this is the best velocity that can be produced) while the charge of Wetterin powder, 34 grains, as used in the tests of the Magazine Gun Board, gives a muzzle velocity of 1885 feet with a pressure of 51,000 pounds.

" A difficulty attending the use of smokeless powders is the lack of uniformity in the results for the same charge, and the radical differences for but slight changes in the amount of powder.

" Thus, as averages of a large number of shots with Wetterin powder, the following results have been found :

Charge.	Pressure.	Velocity.	Charge.	Pressure.	Velocity.
33 grains.	48,000	1852	35 grains.	55,800	1960
34 grains.	51,000	1885	36 grains.	60,900	2016

"Machine loading cannot be depended upon closer than 1½ grains, which corresponds it will be seen to a variation in the mean velocity of over 100 feet. This is inadmissible and consequently in preparing the cartridges for the Small-Arms Board hand loading had to be followed. Even this, however, does not secure an absolute uniformity, for in the experiments at Springfield, where no variations as large as 1-10 of a grain were permitted, single velocities for the same charge, would occasionally differ by as much as 80 feet. Some loss of accuracy, from the marksman's standpoint, will probably accompany the use of smokeless powders, but as the trajectory is flat *the effectiveness of the weapons in action will not be impaired.*" (The italics are ours.)

The composition of smokeless powders in many compounds is not absolutely known, but it is well understood that nitrated cotton is the basis of them all. Many of the foreign smokeless powders are secrets most carefully guarded. Some of the powders tested at the National Armory consist of 94 per cent. gun-cotton, 5 per cent. nitroglycerine and one per cent. castor oil. Others, such as "cordite," of 50 parts gun-cotton, 50 parts nitroglycerine, both with and without a small percentage of castor oil. So far, the best authorities state that the smokeless powders as a rule are not affected by moisture, in fact may be kept in water, but that they are to a greater or less extent influenced by heat.

Nitrated substances such as gun-cotton, nitroglycerine, etc., begin to decompose when the temperature exceeds 160° Fahrenheit, and powders containing these substances if exposed to such temperature will undoubtedly suffer a change which may materially affect their ballistic qualities. This has been demonstrated by experiment, "when both the Nobel and Wetterin powders exposed to a high temperature for a week showed a decided loss in velocity and pressure."

Storage alone has been observed to produce the same effect on some smokeless powders, but "in the case of the most stable compounds a sufficient period has not elapsed to warrant conclusions on this subject."

The Navy Department has taken preliminary steps to preserve the explosive compounds and smokeless powders, stored in magazines on shipboard, from the deleterious influences of heat and moisture; this applies more especially to magazines located in heated parts of vessels, where proper ventilation can only be secured by blowers. It is expected that in ships provided with

refrigerating plants, methods will be devised by which the equilibrium of heat and moisture can be maintained and the temperature and humidity regulated automatically. In other words, recognizing the instability of certain compounds, it is proposed as far as possible to eliminate *controllable factors* from the problem and thus derive full information respecting the comparative merits of the various compounds and explosives when stored under the most favorable conditions attainable in service.

On the other hand, where the new class of explosives are of the experimental order, they are, as a matter of course, subjected to rigorous tests at the proving grounds, the arsenal and the factory. (See Tables I and II.)

In a late publication, "A Year's Naval Progress," Ensign Edward Simpson, U. S. N., has given a very comprehensive treatment to the subject of "Service High Explosives," and at the risk, perhaps, of presenting some of his data in crude shape, but because much of it is pertinent to the subject matter of our compilation, we venture the following remarks:

Schonbein discovered gun-cotton in 1845 and Sobrero discovered nitroglycerine in 1847, but it was not until Noble discovered in 1864 that they were capable of being detonated, that their full value was developed.

Gun-cotton detonates nitroglycerine, but the reverse does not obtain, and all high explosives are detonated by the fulminate of mercury and some by it only, therefore it stands at the head of the list of detonators.

Shock, friction, or heat of 360 F., decomposes it rapidly, and this rapid decomposition causes detonation to the explosive, but being very local in effect it must be in close contact to develop its full power.

Velocity of transmission of detonation is illustrated by Hake's experiment in which he shows, that should a ton of dynamite be drawn out in a cord seven-eighths of an inch in diameter, and a mile in length and detonated simultaneously at both ends, one-fourth second is required for its consumption. If, however, it simply be lighted at both ends, several seconds are required to dissipate it. Experiment also shows that when 10 pounds of dynamite was exploded against the face of a vertical wrought iron plate one inch thick, holes were produced of 96 and 192 square inches, when the fuses were on the sides next to, or away from the plates respectively, thereby indicating that to obtain the

TABLE I. EXPLOSIVE COMPOUNDS.

No.	Designation.	Specific Gravity.	Weight of cubic foot Pounds.	Ratio of cost per pound.	Efficiency under water. Per pound.	Per cubic ft.	Per cost.	Energies producing explosion. Kilogram-meters.	Foot. Pounds.	Exploding temperature Fahr (Burns)	Freezing Temp. Fahr.	Ingredients.
1.	Explosive Gelatine	1.54	96.3	23.	117.	113.	....	1.80	12.6	570.°	40.°	90% nitroglycerine, 6% nitrocellulose (soluble), 4% camphor.
2.	Blasting "	1.54	96.3	24.	142.	138.	101.	.60	4.2	400.°	40.°	95% nitroglycerine, 5% nitrocellulose (soluble).
3.	Forcite "	1.51	95.4	24.	133.	127.	....	.....	.....	400.°	40.°	95% nitroglycerine, 5% cellulose.
4.	Gelatine Dynamite	1.55	96.9	21.	123.	119.	99.	.....	.....	400.°	40.°	65% blasting gelatine, with 35% (75% potassium nitrate, 24% cellulose, 1% soda).
5.	Dynamite No. 1	1.60	100.0	17.	100.	66.	63.	.50	3.5	360° to 420°	.....	75% nitroglycerine, 25% kieselghur.
6.	Gun-Cotton, Dry	1.06	66.0	27.	87A 100E	66.	63.	.82	5.7	.....	.....	Nitric acid and sulphuric acid on cellulose (tri-nitro-cellulose).
7.	" " Wet	1.32	82.5	.....	80E	66.	63.	2.30	16.1	.....	.....	Nitric acid, cellulose and 25% water (hermetically sealed.)
8.	Nitrocellulose (Soluble)	.....	.....	.....	.....	.....	.....	.72	5.0	.....	.....	Collodion (gun-cotton dissolved in alcohol).
9.	Tonite	1.28 Gravimetric.	80.0	.....	85.	68.	....	.....	.....	.....	.....	52% gun-cotton, 48% barium nitrate, small per cent. charcoal.
10.	Gunpowder	.90	56.0	5.	25.	14.	85.	37.50	225.0	.....	.....	76% saltpetre, 14% charcoal, 10% sulphur.
11.	Nitroglycerine (Fluid)	1.60	.....	.....	81.	.....	....	.41	2.8	.....	.....	The three hydrogen atoms of glycerine, hydroxyle (H O) being replaced by three acid radicals. ($N O_2$) forms the tri-nitro-glyceride. Sulphuric acid added to take up the water liberated during the reaction, and prevents formation of mono and di-glicerides.
12.	" " (Frozen)	.....	.....	.....	.....	.....	....	.80	5.6	.....	.....	
13.	" " (Part Frozen)	.....	.....	.....	.....	.....	....	.27	1.9	.....	.....	
14.	Bellite (Cartridges)	1.20	75.0	.....	.....	.....	....	62.00	437.0	.....	.....	Ammonium nitrate with nitrobenzole, mixed with saltpetre. (Sprengel type).
15.	"	1.20	75.0	.....	110.	.....	....	292.00	2077.0	300.°	.....	
16.	Dualin	1.20	75.0	.....	111.	.....	....	.....	.....	(194° melts)	.....	Nitroglycerine with cellulose or nitrocellulose.—Wood fibre or pulp.
17.	Hercules Powder	.....	.....	.....	106.	.....	....	.....	.....	.....	.....	Nitroglycerine 77%, mag. carb. 20%, wood pulp 2%, sodium nitrate 1%.
18.	Giant Powder (Dynamites.)	.....	.....	.....	83.	.....	....	.....	.....	.....	.....	Compounds of nitroglycerine, with explosive base, such as gunpowder, nitrate of soda, etc., in lieu of the inert kieselghur of dynamite.
19.	Vulcan " No. 2 (Dynamites.)	.....	.....	.....	82.	.....	....	.....	.....	.....	.....	
20.	Atlas " (Dynamites.)	.....	.....	.....	100.	.....	....	.....	.....	.....	.....	
21.	Judson " (Dynamites.)	.....	.....	.....	78.	.....	....	.....	.....	.....	.....	
22.	Extralite	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Nitrate of ammonia with hydro-carbon or chlorate of potash.
23.	Hengst Powder	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Oat straw pulp with two sulphur and one nitric acid.
24.	Ecrasite	.....	.....	.....	150.	.....	....	.....	.....	.....	.....	Blasting gelatine, with sulphate or hydro-chlorate of ammonia.
25.	Rend-Rock	.....	.....	.....	78 to 95	.....	....	.....	.....	.....	.....	Various combinations of nitroglycerine and explosive bases.
26.	Roburite (Sprengel Class.)	1.40	.....	.....	88.	.....	....	.....	.....	.....	.....	Chlorinated di-nitro-benzole, with ammonium nitrate.
27.	Rack-a-Rock (Sprengel Class.)	1.70	.....	.....	110.	.....	....	.....	.....	.....	.....	Chlorate of potash, impregnated before use in liquid hydro-carbon (dead oil).
28.	Hellofite (Sprengel Class.)	1.4	.....	.....	.....	.....	....	.....	.....	.....	.....	Napthalene, phenol, benzine, any one of these in fuming nitric acid.
29.	Securite (Sprengel Class.)	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Meta-di-nitro-benzole with nitrate of ammonia or potash.
30.	Picric Powders (Sprengel Class.)	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Nitric acid on indigo or with carbolic acid.
31.	Designolle (Picric Acid Powder.)	.....	.....	.....	68.	.....	....	.....	.....	.....	.....	Picric acid with potassium.
32.	Brugere (Picric Acid Powder.)	.....	.....	.....	81.	.....	....	.....	.....	.....	.....	Picric acid with ammonium.
33.	Mélenite (Picric Acid Powder.)	1.70	.....	.....	.....	.....	....	.....	.....	.....	.....	Picric acid with collodion jelly (see cresilite).
34	Emmensite (Picric Acid Powder.)	1.80	.....	.....	.....	.....	....	.....	.....	.....	.....	Picric acid, nitrate soda, nitrate of ammonia (equal).
35.	Lyddite (Picric Acid Powder.)	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Picric acid compound.
36.	Ecrastite (Picric Acid Powder.)	.....	.....	.....	110.	.....	....	.....	.....	.....	.....	Supposed to be picric acid, or gun-cotton compound.
37.	Cresilite	.....	.....	.....	.....	.....	....	.....	.....	.....	.....	Nitrocresol, a coal tar product. 66% mixed with mélenite for shell charges.

REMARKS.—Tonite (9) is excellent where local action and shattering effects are desired, hence good for blasting. Bellite (15) requires powerful detonator when in hard cake, but this is not the case when in granules. Rack-a-rock (27) 250,000 pounds used to blast Flood Rock. Roburite (26) four tons manufactured daily at a factory in Germany, probably for engineering purposes. Bucknill states that in determining the efficiency of gun-cotton as compared with that of dynamite No. 1, it is thought that the grade of gun-cotton used by Abbot may not have been of the highest, or that the dynamite used in the English experiments may have been of a somewhat inferior order hence taking dynamite at 100, Gun-cotton rates 87A, and 100E. Many of the compounds not commented upon are

TABLE II. SMOKELESS POWDERS.

No.	DESIGNATIONS.	INGREDIENTS AND PROPERTIES.
1	Ballistite..... (Nobel Powder)	50% nitroglycerine, 50% di-nitro-celloluse with small proportion camphor or benzole, though not necessarily cubical grains for small arms, and in strips of square cross section for large guns. Adopted by English, sold to Italy at royalty of 11 cts. per pound (160,000,000 small arm cartridges). Known in Germany as C/89. Reported that with 8."27, 238 pounds projectile, velocity 2329 f. s., pressure 14.6 tons. Minister of War in Italy reports that after extensive experiments it has proved entirely satisfactory. Exploded at Avigliano Factory, May 16, 1890. Many killed. No details published.
2	Poudre B..... (Vielle powder.)	Secret compound ; yellow brown tablets, ".07 to ".01 square, thickness of stout note paper. Sir F. Abel thinks it contains picric acid.
3	French BN.....	Modification of Vielle powder, strips ¼ inch thick, of length required for the gun charge.
4	Chilworth Special...	Used until lately in Armstrong rapid fire guns. Ammonium nitrate 38%, potassium nitrate 42%, carbon prepared as in Brown powder (underburnt) 20%, as the ammonium nitrate absorbs moisture it is hermetically sealed.
5	Cordite.....	Much like ballistite in appearance, chocolate brown color, and when broken shows light grey section like pumice stone. Supposed to be nitroglycerine, to which is added tri-nitro-cellulose dissolved in a solvent such as acetone or acetic, either together with some other substance for moderating explosive action, such as lampblack, graphite, solid hydro-carbons. Consistency of moderately thick jelly. Soft and pliable, substance forced through holes, and resulting strings become tough as solvent evaporates. Rate of burning depends on thickness of cord. Maxim's Cordite, 50% nitroglycerine, 50% gun-cotton, or else 2% nitroglycerine replaced by 2% castor oil, in small grains it is easier to manage than in cords, but gives less velocity for same charge. Maxim's Cubes ".12 gauge, Nobel's Cubes .05 cubes, and this latter requires black powder for priming, this addition materially alters the nature of the combustion.
6	Belgian Wetterin...	Secret compound, uneven grain, little lustre (pineapple odor when fired).
7	Dupont's Smokeless.	Like Wetterin, but hard, smooth and bright—(secret compound).
8	Walsrode.....	About equal to Wetterin if not superior—(secret compound).
9	Maxim Cordite.....	50% nitroglycerine, 50% gun cotton with 1 or 2% of castor oil, in cubes ".12 gauge said (in Chief of Ordnance Report 1890) to have given best results, so far, of any smokeless powder, tried at the National Armory, U. S. A.
10	Graynite or Graknit.	Nitrocellulose base has given satisfactory results in Russia.

REMARKS RELATING TO TABLE I ATTACHED TO TABLE II FOR WANT OF SPACE.

E. O. Brown discovered that gun-cotton wet is safe and may be detonated by a priming of dry gun-cotton. A ton of wet gun-cotton has been burnt in closed packages. By coating the surface with acetic acid or ether the moisture may be retained and when in discs the surface of the interior hole is coated in this way to facilitate ignition whilst the remaining surface is coated with paraffine to retain the water. Dry gun-cotton detonates by influence, burns when unconfined and portions only are exploded by the blow of a hammer. Heated to a certain temperature it explodes. When confined or compressed it explodes by heat, shock or detonation. Mélenite when detonated gives off large quantities of poisonous carbonic oxide gas.

best effects the fulminate should be placed on the side away from the opposing force.

Regarding the properties of explosives, Simpson says, that while gunpowder still holds first place as a propellant, it is very inferior in force, as is well known, to that of the high explosives, but from what has been expressed in this paper it is clear that it no longer holds *undisputed sway* as a propellant.

The nitrate mixtures, in which other nitrates are substituted for that of potash, in order to give more rapid or slower rate of combustion, are deemed unsuitable for military purposes, owing to their hygroscopic properties.

To the chlorate mixtures an objection is urged on the ground of sensitiveness to percussion and friction, increased as it is by time and hydroscopic variations; and to their tendency to decomposition in contact with acids, which is an additional objection to their use for military purposes.

The nitro compounds containing nitroglycerine, and the gun-cotton and other nitro compounds, belong to those substances containing carbon and hydrogen which are acted upon by nitric acid or nitrate and sulphuric acid. They also include nitro-substitution compounds such as nitro-benzoles, in which the hydrogen of the benzole is replaced by nitrogen and oxygen; the nitric esters, gun-cotton and nitroglycerine, in which the oxygen of the cellulose or glycerine unites with the nitrogen of the nitric acid; the dynamites, in which nitroglycerine is mixed with either an inert or active base; and the gelatine compounds which include various mixtures containing nitrocellulose.

When manufactured of pure ingredients, while being the most powerful known explosives, many of them possess good keeping and safe handling qualitities, and are capable of being kept for long periods at temperatures under 120° F., some being insoluble in water and some insensitive to shock.

The picric powders under a subdivision, may be nitro-substitution compounds. The picric acid produced by the action of nitric acid on carbolic acid, mixed in combination with a metallic oxide or nitrate under the influence of heat, forms a picrate, the potassium and ammonium picrates being the only ones used in explosive preparations.

In 1873, Sprengel showed that picric acid alone was subject to explosion by detonation and Turpin patented this quality in 1885.

When picric acid is brought into contact with metallic oxide at a high temperature, a picrate is rapidly formed, which when heated will explode and detonate any quantity of picric acid in contact with it.

The most prominent of the picric acid powders are emmensite, lyddite and mélenite.

The class of Sprengel Powders consists of two non-explosive constituents, either solid or liquid, mixed at, or just before the time they are required for use, and form violent explosive mixtures.

They include mixtures of nitric acid with nitro-benzine, picric acid and nitro-naphthaline and a variety of substances mixed with chlorate of potash. The constituents being non-explosives when unmixed, they are entirely safe for storage and transportation, and for this reason very valuable for military purposes. All explosives of this class require detonators, but when nitric acid is one of the constituents great care should be taken that it does not come in contact with the fuse. Bellite, hellofite and roburite are explosives of this class.

We cannot do better than quote in full from Simpson, as follows:

"Assuming gunpowder as a standard at 1, the explosive effects of the various explosives, as given by different authorities, are:

Blasting gelatine	16	Tonite	9.5
Forcite	15	Carbo-dynamite	6.5
Ecrasite	15	Bellite	6
Explosive gelatine	13	Gun-cotton	5.5
Hellofite	13	Mélinite	3
Nitroglycerine	13	Lyddite	3(?)
Dynamite	11	Roburite	3
Emmensite	*10–4.5	Gunpowder	1

* Varying according to grade.

"From the results of the experiments cited above, we can divide the explosives under three heads, viz.:

A.—Explosion caused by impact of small-arm projectiles.	B.—Premature explosions during experiments in powder guns.	C.—No premature explosions by bullets or during firing trials.
Blasting gelatine.	Blasting gelatine.	Bellite.
Dynamite, No. 1.	Explosive gelatine.	Ecrasite.
Forcite.	Dynamite, No. 1.	Emmensite.
Gelatine dynamite.	Gun-cotton, wet (none since 1882).	Hellofite.
Nitroglycerine.	Mélinite (only one explosion).	Lyddite.
	Nitroglycerine.	Roburite.
		Tonite (no firing trials).

"The defect of those included in column A is a very important one, and unfits them for general military use. Of those in column B, wet gun-cotton has shown no unsafe qualities since 1882, and is now considered as the safest known explosive, entitling it to be included in column C. Mélenite has only had two premature explosions during firing trials, and is fully trusted by the French as now prepared. The great explosive effect of the others in column B, however, makes them very desirable for large demolishing charges when fired with low initial velocities and penetration before explosion is not required; and from its non-sensitiveness to explosion through impact projectiles, explosive gelatine seems to be the one best fitted for use in pneumatic and other guns where the propelling force of moderate strength, not subject to great variations, is gradually applied.

"Those included in column C have been shown to possess the requirements of stability, safely, non-sensitiveness to shock, and shattering effects. suitable to military uses from powder guns; but of them hellofite is placed at the disadvantage of requiring special shells, the interior fittings of which reduce materially the charge capacity, and hence the destructive effect; and tonite has not been sufficiently experimented with to prove its adaptability under various conditions.

"Summing up, we find explosive gelatine eminently suitable for use in pneumatic guns; and as bursting charges for projectiles from powder guns

Name.	Type.
Bellite	Sprengel.
Ecrasite	Gelatine.
Emmensite	Picric Powder.
Gun-cotton (wet)	Nitric Ester.
Lyddite	Picric Powder.
Mélenite	Do.
Roburite	Sprengel."

Without disparaging the Brown cocoa powder now in use for heavy guns, it may be said that it is made with a percentage of sugar and water not common to the ordinary powders, and whilst it gives high velocities and moderate pressures in our large calibre guns, yet the underburnt charcoal increases its instability, and evaporation of its moisture produces at times the most unexpected, and we may even say, dangerous pressures.

Taking these views in conjunction with statements* lately ap-

*The London *Engineer* says: "Brown cocoa powder, though so well adapted for giving the best ballistic results, is, nevertheless, a highly erosive powder. This erosion or destruction of the surface of the bore by the powder gases at an enormous heat and pressure, is a most serious question. The very heavy charges now employed in our heavy guns, and the relatively long time during which the high temperature and pressure of explosion are maintained in a long barrel, have aggravated erosion to a very great extent, thus shortening the life of the guns. In these guns, if the highest charges are used, erosion, which no skill of construction can modify, is the result, and soon renders repair or relining necessary. Reduced powder charges allow a materially pro-

pearing in the London *Engineer* and *Army and Navy Journal* it will be seen that Major Scott, R. A., in his remarks prefacing this paper is not alone in his prognostics.

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longed life to the bore; and there is also a great difference in erosive effect between powders of different composition. Unfortunately the S. B. C. powder which has up to the present been found, for ballistic reasons, most suitable for large guns, is also one of the most erosive; and powder makers have not so far succeeded in giving us powder at once good for ballistics and possessing the non-eroding quality so greatly to be desired." The *Army and Navy Journal* speaking of the experiments at Sandy Hook, N. J., with the 8-inch rifle says: * * * "In the first round a charge of 30 lbs. of powder, and shell weighing 300 lbs., were used, giving a velocity of 1497 ft. and pressure of 18,000 lbs. In the second shot the charge was increased to 45 lbs., the velocity recorded being 1990 ft., and the pressure 31,160 lbs. In the third round, with 50 lbs. of powder, the remarkable high velocity of 2162 ft. per second was given, the pressure being about 38,000 lbs. The velocities were taken 165 feet from the muzzle. The energy of the shot at the muzzle was 9720 ft. tons. The good results of the last round can be appreciated when it is remembered that with a charge of 130 lbs. of brown powder, with the same weight of projectile as used in the above three rounds the highest velocity attained with the normal pressure of about 37,000 lbs., was 1935. With a 250 lb. projectile, such as used in the navy gun, it is estimated that a velocity of 2345 ft. can be secured with 50 lbs. of the same brand of smokeless powder, and this, too, without increasing the pressure beyond 37,000 or 38,000 lbs. When the gun was fired a small volume of smoke shot from the muzzle, but quickly dissipated. Another notable circumstance was the clean appearance of the powder chamber after the firings, there being no residue whatever." (This extract from the *A. and N. Journal* is confirmed by Capt. Frank Heath, Ordnance Department, Commanding Sandy Hook Proving Ground.)

POST SCHOOLS.

By ALFRED C. SHARPE, A. M., First Lieut. 22d U. S. Infantry.

Gold Medallist, M. S. I.

THE law providing for the establishment of Post Schools was enacted a quarter of a century ago. It is recorded in Section 1231 of the Revised Statutes and reads as follows:

"Schools shall be established at all posts, garrisons and permanent camps at which troops are stationed, in which the enlisted men may be instructed in the common English branches of education, and especially in the history of the United States, and the Secretary of War may detail such officers and enlisted men as may be necessary to carry out this provision. It shall be the duty of the post or garrison commander to set apart a suitable room or building for school and religious purposes."

Many orders, rulings and interpretations have been published from time to time to give effect to this wise measure, and liberal provision has been made for supplying the necessary desks, textbooks and stationery required for purposes of instruction. And yet, notwithstanding these earnest and laudable endeavors, the average post school remains to-day what it was fifteen and twenty years ago,—a disappointing and melancholy spectacle. It is the play of Hamlet with the part of Hamlet left out. The Quartermaster's Department is ordered to provide the necessary buildings and books, and compulsory school laws (or orders) may secure the necessary enrollment and attendance, but the attention and interest of pupils and the delightful influences and effects of the schoolroom which originate in and flow so naturally from the mind of a trained and competent teacher can never be secured "by order." The fact that Private Mulvaney has been duly detailed as teacher, and is receiving fifty cents a day for his performances in that rôle, does not make him one. The science of pedagogics demands some higher diploma than a post order: and the money that is now so liberally expended in books and maps and other costly material, together with the twenty or twenty-five thousand dollars that is annually paid out for extra duty to so-called teachers

is practically a dead waste, and will continue so to be until some provision is made to secure competent, professionally trained instructors. Exception to this statement will doubtless be taken by those whose observation has been limited to the most favored posts, but it is believed that a visit to almost any school on the frontier from Pembina to Fort Brown will vindicate its correctness.

To illustrate: At a large post in the far west where a chaplain was in charge (pursuant to law), forty-three children were found crowded into a "black hole" not fit for the accommodation of a well-bred cow. The temperature without was below zero; within, it stood at blood heat and the air was foul and stifling. No thermometer was provided by which to gauge the temperature, and the teacher would doubtless not have appreciated its use had he possessed one. The pupils were listless and inattentive—(how could the brain work in such a poisoned atmosphere?) and the old hum-drum, droning, mechanical methods were in vogue which prevailed in France and Ireland a hundred years ago. But what, we pray you, could be expected of a school superintendent whose grammatical attainments permitted him to report his departure for the neighboring village in the following elegant diction:

"To the Post Adjutant

"Sir.—I have went to town!"

In another school at a different post, the youngsters were perched on great home-made benches belonging to the chapel; their dangling feet strained vainly to touch the floor, and their little faces could just be seen peering above the high desks in front of them. The windows were innocent of curtains, if we except the dust laden cobwebs which hung in graceful arches from their casings, and pupils sitting near by were exposed to the full glare of the sun which threw a blinding light upon the open pages before them. In addition to a few maps, an insurance company's calendar and a bracket lamp, the only ornament which adorned the walls was an immense brick-red print or chromo about 20 by 40 inches in size. It represented a large manufactory composed of several huge buildings from which ascended innumerable lofty chimneys. Everything indicated enterprise and thrift,—truly an admirable illustration of industrial energy and success for the young mind to feed upon. At the lower edge, near the gorgeous frame which surrounded it, in large plain roman letters—(shade of Pestalozzi deliver us!)—was the legend: "*Anheuser-Busch Brewing Assoc'n, Saint Louis, Mo.!*"

A history class was discussing our war with Mexico; both pupils and teacher referred to the American cavalry as "a detachment of United States Dragons."

At a certain post where the writer was detailed to hold an examination of candidates for the position of assistant teacher, one aspirant located the Adirondack Mountains in Alaska and was unable to name the dates of the great events of American history. Yet, a few months later, the regular incumbent or Head-master! having been found too drunk to meet his classes, this man was duly installed as his successor!

The educational acquirements of still another of these military pedagogues, made "by order," will appear from the following note received by a parent:

"Lieutenant—In reply to your question I do not let the schoolars leave the room unless it is necessisary. And never untill school has ben called 25 min."

And the chirography is worse, if possible, than the spelling. This teacher also gave out a problem in arithmetic as follows:

"If a yack-et sails twelve miles in one hour how far can she sail in three hours?"

Upon consulting the text it was discovered that the strange craft referred to was a yacht!

Sufficit. The subject is by no means new. Illustrations similar to the above could doubtless be furnished by every officer who has visited and listened to recitations in post schools. Numerous reports and suggestions have also been submitted and the War Department has been painfully apprised of the many difficulties and embarrassments which Post Commanders and their subordinates have encountered in their endeavors to comply with the law. Many efforts, too, have been put forth to cure these defects and to place the educational system for enlisted men upon a footing commensurate with its importance. It will be of interest to pause here for a moment while we trace briefly the course of official sentiment and action on this subject during the past ten or twelve years.

The law had been in operation (or rather on the statute book) for upwards of eleven years, but with most indifferent results, when, on Dec. 31, 1877, the Secretary of War organized a "Board on the Establishment of Schools at Military Posts." This Board was composed of Quartermaster-General Meigs, Adjutant-General Townsend and Judge-Advocate-General Dunn, with Major C. H.

Carleton as Recorder. Having "maturely considered the subject of the education of soldiers," it submitted its report to the Secretary of War, who caused it to be published to the Army in a General Order (No. 24 of 1878). The Board says:

"To carry out any elaborate system of education under this statute would require considerable annual appropriation for teachers, books and other appliances. To enforce compulsory attendance upon schools would add new penalties for its infraction which might engender discontent among men not inclined from want of capacity or other cause, to attend school, and might increase or lead to desertion."

The subject thus received very little encouragement from the deliberations of these learned officers, and no very decisive steps were taken in advance, although Chaplain Mullins was placed "in charge of Education in the Army," and by a General Order (No. 23 of 1880) "all officers were enjoined to coöperate in the encouragement of study and the promotion of learning and intelligence among the enlisted men of the Army." In a subsequent order of the same year the Secretary of War directed that the monthly reports of Post Schools (required at that time) be transmitted to the Adjutant-General through the Department Commander "in order to acquaint him with the *status* and needs of the Post Schools within his Department, and to enable him to make such suggestions and recommendations as he may consider conducive to the full attainment of the purpose for which they are established."

The subject, evidently, was difficult, and opinions widely diverse. Chaplain Mullins, in his annual report for 1882, declared that "experience has shown that compulsory attendance at school decreases instead of increases the number of desertions," and that "many officers, including six colonels, have suggested in their reports that Post Commanders be given authority to compel attendance at school whenever they judge it necessary for the welfare of the enlisted man."

On the other hand we find Inspector-General Baird giving his attention to the matter five years later in the following decided language:

"The reports regarding Post Schools indicate as those of previous years have done, that they are of but little benefit to the enlisted men, because very few are willing to attend them. This unwillingness of enlisted men to avail themselves of the advant-

ages of education offered, has led several officers to recommend that illiterate soldiers be compelled to undergo a course of schooling. To this I am absolutely opposed because, however desirable learning may be from a humanitarian point of view, I think it would violate the fundamental laws of our government to compel any citizen to go to school against his will or his conscientious scruples, and if the right existed to compel enlisted men to do so, by the same right captains and lieutenants might likewise be required to attend."

The sacred rights of the citizen, however, had been duly guarded by a circular several years before (April 10, 1883) in which it was announced that "compulsory attendance of enlisted men at Post Schools is not required."

None of the plans suggested seemed quite feasible, but the large space given to its consideration in the annual reports emanating from the War Department, showed that the question was absorbing much official thought. In his report for 1883 Adjutant-General Drum said:

"This subject is one of deep solicitude to all interested in the furtherance of the best interests of the service, whether viewing its immediate benefits to the ranks or its future advantageous results when the men who now fill the Army are restored to the full exercise of the privileges of citizens."

He then gives an interesting synopsis of the school reports received from the various geographical departments and concludes:

"Teachers must be fully fitted for their position and combine with the possession of knowledge the capacity to impart it. Their services being for the benefit of the whole army they cannot with propriety be members of a company or regiment, and they must be given suitable rank to insure attention and respect. Soldiers will be slow to obey or respect a teacher whose position in quarters is possibly inferior to theirs, and it is demoralizing in the extreme when they find that their voluntary studies must be relinquished for a time because their instructor (superior to them in acquired knowledge only) is undergoing merited punishment in the guardhouse, possibly for drunkenness." In the same year Secretary of War Lincoln wrote: "The work (of teaching) cannot be done satisfactorily by the detail of enlisted men, as is now necessary. At three of the military posts the officers and enlisted men have themselves hired teachers at a compensation of fifty dollars per month."

In some cases authority was sought to divert the post fund to the pay of civilians, by which to lighten the burden which fell so heavily upon the pockets of the officers and men, but the commanding officer of Fort Selden, New Mexico, was promptly informed that "a civilian school teacher could not be paid for his services from the post fund."

In 1885 the Adjutant-General renewed his former recommendation as to compulsory attendance and again said: "Teachers, for obvious reasons, should not form part of the company organizations, and must be specially fitted for their important position."

Finally in 1889, an effort was again made to arrive at a practicable method, and a general order directed that zealous and efficient officers be detailed in charge of all Post Schools. Commanding officers are again "enjoined to personally aid and encourage those needing instruction in acquiring all that the law requires." Attendance at school was made a military duty for all young soldiers, and Adjutants-General of Departments were directed to render annual reports "setting forth specifically the failure or neglect of any post commander to take interest in or facilitate the operations of the schools." The allowance of text books, maps, globes, and school supplies was also prescribed in subsequent orders, and it was announced that as the reports received indicated a divergence of views as to methods of management and instruction, "such methods will, for the present, be left to the discretion of Post Commanders."

These reports and orders indicate that the system, if we may dignify it by such a name, had not been a success. They also point with equal clearness to the cause—the lack of competent teachers. "It is the spirit which quickeneth," recently wrote Edward Everett Hale. "It is the man or the woman; not the book or the method."

Perhaps it would be conducive to a more intelligent understanding of the case, to indulge ourselves in another brief digression and inquire, Is there a real work for the Post School to do? If every soldier who is enlisted is of good character and temperate habits, and has a competent knowledge of the English language, as required by paragraph 908 of the Regulations, can we not safely leave his further instruction to the squad room and drill ground? Is he not presumably well versed "in the common English branches of education and especially in the history of the

United States," as the law we have quoted requires? Let us see.

The total number of enlistments for the ten years ending with 1889 was 68,604. Of this number 26,017 were of foreign birth, or an average of 2601 aliens per year. This proportion is probably increasing, the enlistments for 1889 showing 3273 foreigners against 4896 native born. Thus about forty per cent. of the young men who annually enter the Army are from lands beyond the sea. Some of them, indeed, though a very small number, have been fairly educated at home, but they have little knowledge of our written language and are quite ignorant of the history and geography of our country and of the genius and character of Republican institutions.

It is also important to note that the number of children over five years of age at army posts was shown in one of the reports of Chaplain Mullins to be 2011, and those who reside near garrisons and whose admission to Post Schools is contemplated in paragraph 326 of the Regulations may be estimated at five hundred or possibly a thousand more. If to these two classes we add the large number of native born illiterate who have neglected or been denied educational advantages in their youth, and who have drifted into the military service, we shall readily perceive, I think, the *raison d'être* and mission of the Post School. We shall also be impressed with the great possibilities for good which are here placed within the reach of the Government, and of the resulting moral obligation which therefore rests upon it. These schools, wrote General Sherman, "if furnished with teachers, can gradually be made universal" and "they will doubtless prove auxiliary to good order and discipline if they do not actually rescue many good men from the usual fate of ignorance and vice."

In his last annual report, the Secretary of War, referring to the subject of desertion, says, "the pith of the whole question is to make the service worth seeking and then enough good men will seek it and be glad to stay in it." But how is this very desirable end to be attained? Manifestly there is something beside bread and butter considerations which make a service worth seeking and which will make good men content to remain in it. Increased pay will not do in, nor yet the abolishment of the trader's grog shop and the establishment of the post canteen, although this was a measure whose benefits have far surpassed all expectation. Our Army is the best paid, the best fed and clothed and

housed of any in the world. Harsh or unkind treatment is unknown; labor, as compared with the daily toil of similar classes in civil life, is by no means excessive, and the health and welfare of the men is tenderly cared for. And yet desertions still do occasionally occur, and good men are purchasing their discharges by scores.

If we would make the service attractive and worth seeking we must look beyond the luxurious animal comforts which our men now so abundantly enjoy. Human beings have moral and intellectual wants and appetites as well as physical, and mental and social starvation may prove as fatal to contentment as bodily restraint and deprivation. If the military service is to be made worthy of intelligent, self-respecting, young Americans, its moral and intellectual tone must be raised by the compulsory physical and mental education of the heterogeneous elements, who enter its ranks. The subject of physical training has recently been ably advocated in the pages of this JOURNAL, and the arguments apply, *mutatis mutandis*, to the plea for mental training. The modern soldier should have a vigorous, intelligent mind in a vigorous, athletic body. Why does our Government continue to withhold these privileges? Why perpetuate this process of physical and mental starvation?

"A few years ago, in sheer desperation," says Captain Mills, "a few men of my battery formed an athletic club or association, and without aid or assistance from any source, provided themselves with clubs and dumb-bells for use on the porches and inside the barracks." In like manner schools have been provided and teachers paid for by private contributions. Men in sheer desperation have paid out their own money and given up their hours of recreation in order to prosecute their studies. "When a soldier is willing to buy his own books and candle," said Chaplain Mullins, "he is anxious to learn and certainly deserves helpful encouragement."

As already indicated, liberal provision is now made for textbooks and material, and the bugbear of compulsory attendance has been cast aside. Is there any practicable method whereby, and without waiting for legislation, we can secure the services of competent teachers? It is well-known that the present system of employing solders on extra duty in this capacity is quite as expensive as the hire of a civilian would be. The following is an exhibit of the income of the military pedagogue:

Pay as private soldier for five years $852.00.	
Average pay per year	$ 170.40
Clothing allowance for five years $202.38.	
Average clothing allowance per year	40.47
Approximate cost of rations, light and fuel per year	78.80
Add 10% for transportation	7.88
Extra duty pay 365 days @ 50c. per day	182.50
Total salary per year	480.05

[If the ration be computed at 25 cents per day as provided for men on furlough we should have $91.25 exclusive of fuel and lights, and if at 30 cents per day as authorized in paragraph 1423 of the Regulations the amount would be $109.50.]

Nearly all garrisons are sufficiently large to require the services of additional teachers who are paid during the enlisted men's school term, from November 1st to April 30th. Adding one-half year's salary to the amount above determined we should have for two teachers (principal and assistant), the snug sum of $720.07. If we adopt nine months as the school year, deducting the usual Christmas and spring vacations, aggregating about one month, there would remain about eight months' work for the principal and six months for the assistant. This would allow a principal at $60 per month and the assistants at $40 each. Now, can professional, well-qualified teachers be secured at these figures? The following letter from the president of a flourishing normal university will be found of interest in connection with this inquiry:

"APRIL 23, 1891.

"*Dear Sir*:—Your letter of late date is before me for consideration. In answer will say that we can furnish from five to six hundred teachers every year. The average salary of our graduates who teach is about $75 per month for eight months; but there are many who have not graduated who would be well qualified to teach a Post School.

"There are several questions I would like to ask:

"1st. Would these teachers be expected to drill with the battalion?

"2d. Would they have to do guard duty?

"3d. Would they have to do police duty or things of that nature?

"If they would, I doubt whether many would enlist. If they would be free from such duties, you can safely depend upon the

normal schools to furnish all the teachers you want. We can do it ourselves. I think that you could get teachers to enlist for three years at $36 per month, by having furnished quarters, fuel, light and clothing, providing they do not have to do military duties. Probably three years would be longer than many of them would like to enlist, but I think a hundred could be found who would.

"Very respectfully, etc."

The writer of this letter has been identified with normal education for many years, his school has an annual enrollment of over 2400 pupils, and his statements may therefore be accepted as conservative and reliable. Now, what does he say? This experienced educator assures us, "you can safely depend upon the normal schools to furnish all the teachers you want;" but on what conditions?—"Providing *they do not have to do military duties.*" If we are willing to accept them as professional non-combatants and accord to them the same rights and privileges enjoyed by our hospital stewards and other non-commissioned staff-officers, we can get all the teachers we need, and of the best capacity and qualifications. Surely this is a reasonable concession to make in return for the immeasurable advantages we should secure both to the soldier and to the service. No legislation would be required to establish a separate rank, grade or title, although these would ultimately follow. It is not the uniform that wins the confidence and respect of pupils, but the man who is in it. It is believed, therefore, if special regulations were promulgated, providing that any graduate of a normal school of good repute, who was accepted as a recruit, should be immediately assigned to duty as post school teacher; that he should be provided with separate quarters (or a separate room), fuel and light; that he should be exempt from all military duty except such as pertained directly to his office as teacher, and that during all vacations and at least three months in every year he should be entitled to a furlough, unless his services were required during the summer months to conduct special sessions which might be prescribed at certain posts by the Secretary of War; the Government would at once secure the benefit of the best normal training and culture in the country. If it were thought desirable to give the modest uniform of the private some distinguishing feature, an appropriate badge might be prescribed as is now provided by paragraph 27 of the Regulations for candidates for pro-

motion. Teachers, so enlisted, should also be assigned to duty at posts most remote from their companies; they should be attached to the hospital corps for muster (messing, pay, etc.), and should be treated in all respects as members of the post non-commissioned staff.

Our Post Schools have other pressing needs, though of less importance, which can be as readily adjusted.

Under the present system, text books are prescribed by department commanders, and there are doubtless as many authors and editions now in use as there are departments. Troops going from one department to another are therefore liable to find an entirely different system of books, and instead of resuming their work in a course with which they are familiar, they must begin anew or skip. Text books should be prescribed by some central authority, who should also designate the number of hours per day that schools should be held, leaving to post commanders to fix them in the morning or afternoon according to circumstances. The same central authority should also name the holidays to be observed and all others should be prohibited. At present every transitory circumstance or event, as muster day, pay day, St. Patrick's day, etc., is seized upon as a pretext for dismissing school. Call-bells for assembling classes and clocks by which to time recitations should also be provided. If these articles cannot be supplied in addition to the elegant and costly terrestrial globes which are now on the list, it would be wise to dispense with this luxury for the present. The clock is a necessity.

It seems that too much is expected, in this work, of post commanders. Very few commanding officers have the time necessary to meet its demands. They are generally occupied during the morning hours with office and other duties, and can make only the most infrequent visits to the school. They must depend largely upon the teacher or the "officer in charge" for their information, and if not disposed to accept the recommendations which are submitted as to vacations, excuses, exemptions and questions of discipline and government, which is sometimes the case, there is no immediate remedy over, and the school suffers in consequence. But if intelligent teachers were employed these questions could generally be entrusted to them for proper adjustment.

It also appears to be an unsatisfactory method to require captains to ascertain the educational qualifications of their men, and

to select such as they deem fit subjects for school. All recruits should be brought before the teacher for examination as soon as they join, and those who fail to reach a prescribed standard should be enrolled and required to attend school until they can reach it.

These and other perplexing difficulties which now beset the path of the post commander or of the "zealous and efficient officer in charge of schools," would doubtless soon disappear if we were to secure competent professional instructors, who make teaching their business, and who would have a direct personal interest in holding the needs of the service continually before the eyes of those who are in position to meet and provide for them.

THE MAGAZINE STAFF AND AMMUNITION SERVICE IN A SEA-COAST FORT.

By CAPTAIN JAMES CHESTER, 3d U. S. Artillery.

THERE is no such organization in our Army as a magazine staff. Even in our largest sea-coast forts the magazine service is practically ignored. There is, of course, the ordnance sergeant, who carries the keys of the magazine, and, with the help of temporary details of men, keeps it in order and issues the ammunition for salutes and drill purposes; but the idea of a trained staff in connection with magazine work seems never to have entered the heads even of our text-book writers. Nevertheless, such an organization would be an absolute necessity if any of our forts were called upon to maintain a prolonged action against a hostile fleet.

Want of organization in all their departments is one of the most glaring defects of our sea-coast defenses. Their armaments are merely collections of guns. They have not been divided into fighting units of convenient size for command, nor is it anywhere apparent that such division is deemed important. They are in a condition analogous to a battalion of men without company organization. When the commandant's voice cannot be heard, the gunners will act upon their own judgment. And this is the fundamental defect in all our sea-coast garrisons. It is the defect which bore such bitter fruit for the Confederates at Fort Morgan, and, if not corrected, will nullify our best efforts, even after we have received our new armament.

But want of organization is only a symptom of our disease. The professional blindness which fails to see its importance is the evil to be deplored. It will not do to say that our guns are out of date. We might organize our garrisons even if we had nothing but quaker guns. But no attempt has been made in this direction. Our artillery troops have been permitted to degenerate into indifferent infantry. And judging from the requirements of inspectors, that condition is all that is expected of them. Much might be done even with our old-fashioned armament. To be sure most of our forts are inadequately manned, and complete

organization would be impossible. But if even a single battery —four guns—were organized on a fighting basis in any of our sea-coast forts, and equipped with all essential apparatus for range-finding, gun-laying and salvo-firing; if the ammunition and magazine services were set in operation, and the battery were exercised both as an independent unit, and as a member of the group, an object lesson would be exhibited to our officers and soldiers, the teaching power of which would transcend anything that could be attempted under our present system.

There is not in our garrisoned sea-coast works the slightest semblance of a fighting organization. If any of them were called upon to-day to do battle against a hostile fleet, its garrison would be assigned in a haphazard manner,—probably according to the rank of the captains, certainly not with any reference to special fitness or previous training. The ordnance sergeant would muster at the magazine, and the adjutant would detail operators and assistants for the range firing and other services. In other words an effort would be made to effect a fighting organization in the face of the enemy. This is never wise and rarely possible. No man can do everything equally well, no captain can command a sea-coast battery, unless he is perfectly familiar with it. He must have studied its field of fire until he thoroughly knows every inch of it. He must know the exact distance to every distinguishable land-mark in it. He must be able to estimate, with close approximation to accuracy, the distance of any moving object within its limits at any moment. He must know the guns and all about the battery—its equipment, its range-finding, gun-laying and salvo-firing arrangements. He must know all about its service magazines and their contents, and its shell-filling room and its equipment. Also its system of supply from the main magazine, and its means of communication with the group commandant. In fact he must know so much about his own battery, that he has no spare room for knowledge about any other. In short he must be an expert with his machine. He must have studied it and practised with it until he is master of it. And his officers and men are exactly in the same case. Efficiency is the fruit of persistent training at the identical machine which they will have to operate in action.

A sea-coast fort is a group of units each of which has a perfect organization in itself. The fort is an organization of a higher order than the battery and has important functions to perform in

the drama of battle; but in every well-organized group the functions of the fort and those of the battery would never conflict. The commandant of the higher might assume control of the lower unit at any moment of an action, without creating confusion or causing a moment's delay. But all this was fully treated in our last paper, and need not now be discussed. We deemed it advisable, however, to preface our remarks on magazine service by a few words on the fighting organization of sea-coast forts, in order that we may carry with us some idea of the complete machine while we investigate in detail the mechanism of one of its parts.

There are in all our sea-coast forts and batteries two kinds of magazines, namely, storage magazines and service magazines. In compact works there is, as a rule, only one storage magazine, but there are always several service magazines. There should be at least three service magazines to every battery of heavy guns in the work. In old-times when sea-coast guns, and consequently powder charges, were much smaller than they are now, service magazines were less numerous. In those days the budge barrel was the real service magazine, and as it was placed near the gun, and held quite a number of cartridges, the necessity for ammunition detachments was not apparent. But modern charges have made the budge barrel impossible, and created the necessity not only for numerous service magazines, but also for an organized ammunition service. This necessity has been overlooked by artillerymen.

The storage magazine, or as it is always called, "*The* Magazine," is the grand depôt for the powder supply of the work. Its position, having been determined by considerations of safety from an enemy's fire, is not always convenient so far as the distribution of powder to the service magazines is concerned. Indeed, the engineer has manifestly ignored that question altogether. He has taken infinite pains to secure safety for the powder while in the magazine chamber, but has made no provision for its safety while in transit to the service magazines. This is a grave defect in all our works.

But in order that we may see things as they actually are, let us enter—in imagination—one of our best sea-coast forts, and ask to be shown the storage magazine. We shall find it, no doubt, in a wisely chosen position, so far as safety is concerned; substantially built, well ventilated, and conveniently arranged for storage. But it has no filling room, and no bomb-proof vestibule to which the

ammunition service men of batteries can come for cartridges, when the service magazines are exhausted. The absence of a filling room indicates that the engineer intended either that the powder should be issued in original packages, or that cartridges should be made up in the magazine. There are serious objections to both alternatives. The former is inconvenient and the latter risky. If powder be drawn in original packages and there is no filling room near the storage magazine, cartridges must be made up somewhere else. The powder must be twice handled and twice transported, which would quadruple the chances of accident. There should be a filling room, near the storage magazine, where cartridges could be made up.

But we would see a service magazine. For this purpose we are conducted to one of the fighting units of the fort. It is an open barbette battery of four 15-inch guns, and is provided with three service magazines. The guns are mounted in pairs with heavy traverses on the flanks and between the pairs, and there is a service magazine in each traverse. We enter one of them and find the chamber ten feet long, four feet wide, and six feet six inches high. The capacity of such a chamber is 24 barrels. The barrels are stowed in one tier, four barrels high, so as to leave a passage two feet wide on one side of the barrels and an air space of four inches on the other.

Now the minimum charge of powder for a 15″ gun is 100 pounds for shot. Our service magazine therefor, is constructed to hold 24 cartridges, and as it is intended to supply two guns, the battery would go into action with twelve rounds per gun in the service magazine; the magazine in the other end traverse being an exact duplicate of the one described.

The magazine in the middle traverse is used as a shell-filling room, and if the powder be received in original packages, would also be used as a cartridge-filling room.

Now, in any hotly-contested action, where well-trained men were doing their very best, it will not be deemed extravagant to assume that the guns of such a battery as we have described are fired once in ten minutes. That would be six shots per gun per hour. So, in two hours' firing our service magazines would be empty unless they had been replenished in the meantime. Manifestly they ought to be replenished. The service magazine is to the sea-coast gun what the limber is to the field gun, and should be kept filled accordingly.

But our storage magazine is some distance off. It is on the opposite side of the work, and fully four hundred yards away. We therefore ask our guide, the ordnance sergeant, what provision is made for the transportation of powder from the storage to the service magazine during an action? The sergeant points complacently to a hand-cart near by, and says there is one such cart for every fighting unit, and the batteries furnish the necessary men. We examine the cart. It is evidently a powder cart, built expressly for the purpose, and has a capacity of four barrels. It is covered and provided with a lock and key. The lock and key is doubtless considered a great protection. The cover, too, is useful in its way. But how well either would ward off a bursting shell is quite another matter.

But let us pass the cart. Its makers might explain that it was built for peace and not for war, and give some carping critic the opportunity to ask if the explanation extended also to the battery. We accept the cart. With it the men on ammunition service are supposed to keep the two service magazines at the battery always full. Now six cartridges per gun per hour are fired away—twenty-four cartridges per hour for the battery. So that hand-cart must carry 2400 pounds of powder every hour from the storage to the service magazine, and, as its capacity is only four barrels—400 pounds—it must make six trips per hour during the action. Now the distance from the storage magazine to the battery is 400 yards—800 yards for the round trip. The hand-cart therefore must travel 4800 yards—about $2\frac{3}{4}$ miles—per hour, if it would keep the battery supplied during a hotly contested action.

Such a gait with a loaded hand-cart is manifestly impracticable. The hand-cart service would certainly break down, and the guns would be silenced for want of ammunition at the most critical part of the action. But we might put on another hand-cart. Barring accidents two such hand-carts and six men ought to be able to keep the battery supplied. But accidents cannot be barred in action. Indeed the transportation of powder in this way to a group of say ten batteries—40 guns—during a bombardment, would be one continuous chapter of accidents. The service would certainly break down. It is simply impossible to distribute ammunition in this way under fire.

Now that would be an unpleasant discovery to make during an action. It is manifestly unwise for the artillery to leave this question as the Engineer and Ordnance Departments have left it.

Ammunition service in our sea-coast forts must be made—if not altogether safe—at least practicable. How can this be done?

In attempting to answer this question we must bear in mind that artillery officers can only suggest, they cannot apply any adequate remedy. Constructions of a permanent nature inside a permanent work are sacred to the engineer department, and the artillery officer who should attempt anything of the kind would render himself liable to reprimand at least. But the artillery may indicate what is absolutely necessary to the proper performance of its functions without transgression, and indeed it is the duty of commanding officers to do so. The defects which reveal themselves to artillery officers in the practical performance of their functions are not always apparent to the engineer. The necessity for a latrine in a sea-coast fort for instance is only a recent engineer discovery, although the absence of such a convenience had been a standing artillery grievance ever since the first sea-coast fort was occupied. It is proper, then, and strictly within their rights, for artillery officers, not only to advertise the existence of defects in any work which they may occupy, but to suggest practical remedies therefor. We make no apologies therefore, for the following observations and suggestions upon the safe and speedy transportation of ammunition from the storage to the service magazines inside sea-coast works.

It is well to remember, too, that in any prolonged action the supply of projectiles near the batteries will also have to be replenished. Any scheme therefor which fails to adapt itself to this requirement must prove unsatisfactory.

The best way of transporting cartridges from the storage to the service magazines during an action is by means of an ammunition railway. An endless, single track, narrow-gauge railway, passing in rear of every battery and service magazine, and through the shot sheds and vestibule of the filling room near the storage magazine, would, in our opinion, be the best solution of this problem. The track should be sunk sufficiently below the level of the parade, to afford reasonable protection, or it might be protected by a parapet on the parade side, or even made bombproof throughout. At many of our sea-coast forts underground ammunition railways are perfectly practicable, and the transportation of ammunition in them, might be made fully as safe, as its storage in the magazine chamber.

In the case of an underground ammunition railway, a lift or

elevator would bring the powder directly into the service magazine, and there would be no exposure. In the other cases mentioned, there should be a short siding in rear of every service magazine and battery, and a longer one at the shot sheds, and in the vestibule of the filling room at the storage magazine, for the accommodation of trucks loading and discharging. There would of course be some danger in these cases, but as compared with the hand-cart method they would be reasonably safe.

Travel upon the ammunition railway should always be in the same direction, and as the various turn-outs remove any necessity for blocking the track, travel would never be interrupted. Every battery would have an open road to and from the storage magazine and shot sheds at any time; confusion would be impossible, and supply reasonably certain.

It is unnecessary to enter into details here as to the character of the rolling stock on this ammunition railway. The road should be of twenty inches gauge—the length of a powder barrel—and the transportation trucks should be 10 feet long. There would of course be powder trucks and shot trucks. The powder truck would carry twelve barrels of powder, and the shot truck six 15″ shot, or their equivalent of smaller calibre, which would be ample loads for hand propulsion. When loaded with shot the truck would carry 2700 lbs. and when loaded with powder 1200. The truck wheels should be of paper.

Assuming the existence then of an ammunition railway and knowing the maximum amount of work to be done, we now proceed to devise an organization for the magazine staff and the ammunition service for a sea-coast fort. We see at a glance that the work to be done naturally divides itself into two classes, namely, post work and battery work. The former comprises the work at the storage magazine and the shot sheds, and the latter the work in the service magazines and on the ammunition railway. If there be a general filling room, where cartridges are made up for all the batteries, the work in it will properly belong to the first class. If the cartridges are made up in the service magazines the work will pertain to the batteries. For many reasons a general filling room is preferable, and we shall adapt our organization to that idea.

The officers and men on duty at the storage magazine and shot sheds constitute the magazine staff of the fort; those in the service magazines and on the ammunition railway are the am-

munition service detachments of batteries. The former are under the command of the post ordnance officer, the latter are controlled by battery commanders.

Turning our attention then to the magazine staff, and assuming that cartridges are made up in a general filling room near the storage magazine, we see that the staff must consist of three separate detachments, one in the magazine chamber, one in the filling room and one at the shot sheds, and that to meet the emergency of a prolonged action, each detachment should consist of three reliefs. The question therefore becomes, What should be the numerical strength of these detachments?

Before we can answer that question intelligently, we must first inquire, How many men are needed in the magazine chamber? There should be a commissioned officer on duty at the storage magazine all the time during an action. He commands the relief on duty and supervises the work. There should also be one sergeant, one corporal and at least four privates in the magazine chamber. The sergeant is in charge of the work, the corporal keeps tally of issues; two privates man the magazine hand-barrow and the other two handle the powder barrels.

This may seem at first blush a rather strong party for the magazine chamber, but let us see what they have to do. Assuming that the group to be supplied consists of ten batteries, and that they are all 15″ gun batteries, there would be forty 15″ guns to supply. Assuming also that they are all hotly engaged and firing six shots per gun per hour, in order to maintain the supply of powder at the service magazines, 240 barrels of powder must leave the storage magazine every hour. Now assuming that the men have to travel fifteen yards on an average in going from the magazine chamber to the general filling room, they would travel thirty yards for every barrel delivered, and for 240 barrels, 7200 yards, over four miles per hour. To be sure that is assuming that all the batteries are working full blast. But that should be the basis of our calculation. The service should be equal to any emergency. Now no men, in the close atmosphere of a powder magazine, could maintain that gait for any length of time. It would be necessary therefore, to relieve the hand-barrow men at ten minute intervals, in order to avoid excessive fatigue, and six privates instead of four would be required for the magazine chamber.

We now turn to the filling room, and find that one sergeant, one corporal and seven privates should be on duty there all the

time during an action. The sergeant has charge of the work, the corporal keeps tally of issues, two of the privates lift the powder barrel from the magazine hand-barrow, set it on a bench and take the head out; the third and fourth man, under the sergeant's supervision, weigh out the charge and pour it into the cartridge bag; the fifth man attends to the choke, and stows the cartridge, and the sixth and seventh attend to the issues under the supervision of the corporal.

The relief on duty at the storage magazine and filling room then, should consist of:

1 Commissioned officer—a lieutenant.
2 Sergeants.
2 Corporals.
13 Privates.

And as there must be three reliefs, the whole detachment would consist of:

3 Lieutenants.
6 Sergeants.
6 Corporals.
39 Privates.

We now turn to the shot sheds, and find that there should be one sergeant, one corporal and twenty-four privates on duty there during an action.

Assuming as before, that there are 40 fifteen-inch guns in action, and that they are all working full blast, 240 shot per hour would have to be handled, and loaded upon trucks hourly to maintain the supply at the batteries. Now, 12 men, working in pairs and with proper facilities, can load six 15″ shot on a truck in about three minutes, and 24 men could therefore load 12 such shot upon two trucks in the same time, so twelve shot could be dispatched from the shot sheds every three minutes, or 240 per hour, the maximum task.

The relief at the shot sheds, therefore, should consist of one sergeant, one corporal and twenty-four privates, and for the three reliefs, that is the whole shot shed detachment:

3 Sergeants.
3 Corporals.
72 Privates.

There should also be one officer, a captain, in command of the whole staff, who should also be the ordnance officer of the fort.

The whole magazine staff therefore of a sea-coast work, mounting 40 heavy guns should be:

1 Captain, commanding and acting ordnance officer.
3 Lieutenants, commanding relief.
9 Sergeants.
9 Corporals.
111 Privates.

Which would be about the strength of a battery on a war footing. Perhaps the wiser way would be to put a battery of the garrison on magazine staff duty, filling it up to the number of men required for the purpose. In this way non-commissioned officers and men could be assigned to the duties for which they were best adapted, and systematically drilled into efficiency.

We now turn to the ammunition service of batteries, and as such service will be the same, or at least similar for every battery at the post, we shall confine our attention to one battery. The service is under the control of the battery commander.

When the action opens, the captain finds himself in possession of two service magazines containing 24 cartridges each, and a shell-filling room with the necessary equipment. There are also three railway trucks on the siding in rear of his battery which are under his control. Two of these trucks are arranged for carrying shot, and one for carrying powder.

When the men are paraded for service at the battery, they are told off into five detachments; four of these are gun detachments, and the fifth is the ammunition service detachment. The ammunition detachment should consist of 4 non-commissioned officers and 17 privates.

Their posts and duties are as follows: First the service magazine men, four in number, take station in the service magazines, two in each. Their duties are to deliver the cartridges as they are called for at the door of the magazine, and to receive and stow such cartridges as are brought by the ammunition railway. In order to maintain the supply on hand, 12 cartridges should be received hourly to replace the 12 fired away. The two men then will have to handle 2400 lbs. of powder every hour. Considering the care and responsibility which the handling of such quantities of powder demands, this will be found to give them ample employment.

In the shell-filling room one non-commissioned officer and four privates find employment. If the battery be firing shell, and

that is the case which calls for a filling room detachment, 24 shell will have to be filled and fused, and delivered at the door of the filling room every hour. The non-commissioned officer attends to the fuse; two of the privates fill the shell and the other two deliver it.

And here it is necessary to make some suggestions. A 15″ shell weighs 330 lbs. when empty and 342 lbs. when filled, altogether too heavy to be lifted about by two men in the filling room. But a very simple arrangement would make it unnecessary to lift it at all. A gravity gutter, which should be a substantial and permanent structure, should lead from the railway landing stage into the shell-filling room. When a load of 6 empty shell arrives from the shot shed, they are discharged from the railway truck into the gravity gutter, and are carried by the action of gravity alone into the shell-filling room. A chock at the end of the gutter holds them until wanted.

For carrying the shell about the filling room after it is taken from the gutter a low platform truck mounted upon four truck wheels is required. This truck is run up against the end of the gutter, the chock is removed, and one empty shell is permitted to roll into the cavity prepared for its reception on the truck. The two men then turn the shell until the fuse hole is up, the charge is poured in, the fuse inserted, and the truck rolled to the door where the shell is delivered without having been lifted once during the operations. But in spite of all these adjuncts, as a shell would be called for every two minutes and a half, the filling room detachment would have plenty to do, and might even need reinforcement.

The third ammunition detachment consists of three non-commissioned officers and nine privates, and it mans the ammunition railway trucks. We have assumed that the storage magazine is 400 yards away, measured in a straight line across the parade. But the ammunition railway passes round the work, immediately in rear of all the batteries. Of course the track will not follow the circumference of a circle whose diameter is 400 yards, but the length of such circumference will be an approximation to the length of the road, say 1260 yards. Now, in order to maintain the supply of powder and projectiles at the battery, each railway truck must traverse the road twice within the hour. That is they must travel 2520 yards—less than a mile and a half—per hour to accomplish their task. This gait could be increased without difficulty to two

miles per hour which would allow ample time for loading and discharging.

The ammunition service detachment of a battery then would consist of

1 Non-commissioned officer in the filling room.
3 Non-commissioned officers with the railway trucks.
4 Privates in the service magazines.
4 Privates in the shell-filling room.
9 Privates with the railway trucks.

Making in all 4 non-commissioned officers and 17 privates on ammunition service with the battery.

While these calculations have been based upon the heaviest gun at present in our system, a little figuring will show that it is none too great for guns of smaller calibre. Take for example the 8″ muzzle loading rifle firing 180 lb. shot with 35 lb. charges. Such a gun can be fired once in four minutes or fifteen times per hour. So 525 lbs. of powder and 2700 lbs. of shot per gun would be required hourly to maintain the supply at the battery, practically the same as for the 15″ gun.

We have now reached the end of our subject, and frankly confess that its magnitude exceeds our anticipations. Still we cannot see where a man could be spared. The work to be done is immense and important, and calls for every officer and man that we have put into the organization. But not only must men be forthcoming in adequate numbers when the hour of action arrives, but they must be trained men. Untrained men in a magazine, would be worse than useless. They would be dangerous. Every sea-coast work with a garrison then should have a portion of the men specially trained in magazine staff duty and ammunition service, and exercises in these departments should—occasionally at least—accompany battery drill.

The supply of ammunition has become a recognized and important branch of the tactics of battle. Captain Hess recently sketched and graphically illustrated the methods of ammunition supply in some European armies, and the professional press occasionally gives indications that the importance of the subject is generally appreciated. But the discussion hitherto, has been confined to the supply of an army in the field. We never hear of sea-coast forts in this connection. It seems to be assumed that the supply of ammunition to sea-coast batteries in action is an easy matter. Those who have been there know that it is not. It was

difficult when the powder cartridge weighed less than twenty pounds. What it must be, now that the cartridge weighs over a hundred pounds, may be left to the imagination. But if the day ever comes when we shall be called upon to supply ammunition to modern sea-coast batteries with the means of transportation now on hand for that purpose, the nation will learn a lesson which will not enhance its estimation of our professional ability.

BATTLE TACTICS.

By CAPTAIN FRANK H. EDMUNDS, 1st U. S. Infantry

ARGUMENT.—The idea in view is to provide for a rapid deployment and the most effective use of the rifle. The latter end is best obtained by employing the most skillful shots at that period of the engagement when their fire can be delivered most deliberately and carefully, viz.: in the early stages.

To effect this result it is proposed to form the company in single rank, and then divide it into four equal parts; this provides four lines of attack, 1st, 2d and 3d lines, and a reserve.

To Illustrate.—Taking a company of infantry at its present authorized enlisted strength—60 men—and deducting the sergeants and musicians—7 men—there remain 53 men. Selecting the fourteen best shots of the company, as determined by the regular annual practice, these men will constitute the first line.

They open the fight, and being the most expert shots, are the most effective at long range. The company front will thus be covered by a line of skirmishers with about two yards interval and composed of the best shots in the company—a strong line.

To feed this line when necessary, the 2d line, composed of the next best 13 shots, is deployed at the proper distance in rear.

The 3d line, made up of the next best 13 shots, is deployed as a support to the first two lines.

The reserve—composed of the 13 poorest shots in the company—is then left in its proper place.

These lines are held in supporting distance of each other, the proper distance being regulated by the nature of the ground operated over, being less as the country is more broken and wooded.

With the above formation, as the enemy's position is approached the men of the company join the firing line at a time when the efficiency of their fire can be best utilized.

Only as the time for the final rush approaches have the poorest shots joined the firing line; and this is most opportune, as at this period of the attack—the objective being obscured by smoke and the men under great excitement, all firing as rapidly as pos-

sible, the object being to overwhelm by the mass of fire—there is very little opportunity for deliberation in aiming, and the poorest shot is apt to be as effective as the best.

The advantages claimed for this system are:

Simplicity. Rapidity of execution. Efficiency and effectiveness gained by the employment of the best shots.

No movements based on numbers are used on the battle-field, consequently no confusion owing to missing numbers or changes of position in the line can arise.

The mixing of units—except on key points—is avoided, each company, each battalion, each brigade, etc., fighting under its own officers.

The officers being placed with the first and second lines are in a position to watch the progress of the fight, to lead the men by example and advice, warning them when to advance, when and how, and on what points to deliver their fire.

On key points it is impossible to avoid the mixing of units or commands with any system; there the first troops deployed must be supported and reinforced by others, in order to give the preponderance of numbers necessary to success. At other points of the general line, the formation in single rank, giving four lines when deployed, supported by the troops always held in general reserve, is certainly sufficiently strong for all purposes.

Besides the damage inflicted on the enemy, the early deployment in action of the best shots covers most effectively the movements of the troops in rear.

At the decisive stages of an engagement a company or regiment or larger distinctive body of troops, cannot be called upon to cover more ground than its front in line of battle; it cannot be done without dangerously weakening the general line.

For this reason the interval between skirmishers has been limited as prescribed. Two yards interval makes a strong line, even with but one deployed. Moreover, a regiment of 10 companies of 60 men each, in single rank in line, will cover 330 yards.

This in action is sufficient for one man to overlook.

Providing for a deployment from line is all that is necessary.

With any considerable body of troops there is always cavalry; and with the cavalry screen there is always timely notice of the approach of the enemy. To insure success there must always be time to reconnoitre the ground, in order to place the different arms with reference to their proper employment in action; no

attack to be reasonably certain of success can be made without these precautions and arrangements, and no attack should be made, except in emergencies, which is not reasonably certain to be successful; there is thus always time to place the troops in line before deployment. But the deployment from column may be needed; it is very simple, and has been included.

After teaching the soldier to be self-reliant and to believe that he cannot be beaten; expertness in handling and shooting his rifle; to know how to take advantage of the ground and cover; that he should never give way—fall back—but always advance; after providing simple rules for his government on the battle-field, he should be equal to any emergency. The more he is bound by rules when under fire, rules which can only be made for particular cases, not for all, the more his efficiency is weakened. The nature of the ground modifies everything in warfare, common sense will generally teach the soldier how to take advantage of it, not rules.

Extending and closing intervals, wheeling, passage of lines, all these are impracticable on the battle-field under fire; hence they have been omitted.

There should be a formation and tactics for marching, manœuvring and discipline, and another, entirely distinct, for fighting, the prime object of the latter being to reach the enemy in the shortest time and with the least loss. For the former, Upton's Tactics, possessing the quality of great mobility, and being to a great extent American, are admirably adapted. They should be thoroughly revised, eliminating all movements which seem to be introduced to show how many are possible with sets of fours, rather than for their usefulness.

The great object to be attained when the enemy is encountered is to close with him with the least damage to your own troops and the greatest damage to his. To accomplish this end it is not necessary to go to foreign tactics, but we must go to foreign nations to learn practically the effect of the breech-loader on the battle-field. It is not necessary to follow the victor's tactics to obtain like results. It is reasonable to suppose that after a study of his methods, others may be found which will lead to similar results. Our people are intelligent and brave, and there is no nation better adapted to take advantage of particular conditions.

To take advantage of the ground is everything on the battle-

field, this governs conditions above all other things. Tactics cannot teach this, it is governed by the conditions of each particular case. If we must borrow from foreign tactics, in the system proposed we have good groups and group leaders.

The single rank formation is believed to be the best adapted to our small companies, the only objection being the length of column when on the march. Should the strength of the company be materially increased, which would necessitate a double rank formation, by simply placing the 1st and 2d lines in the front rank, and the 3d and 4th lines in the rear rank, the tactics as written would apply, without further change, to the new formation.

COMPANY BATTLE TACTICS.

1. The company is formed in single rank as at present prescribed.

To deploy the company from line.

2. At a halt or on the march, the captain commands:

1. *First line front.* 2. MARCH.

At the second command, the men composing the first line run forward, and as soon as they leave the ranks distribute themselves at equal distances along the front of the company: if on the march, the company halts.

The captain designates the centre skirmisher of each line as soon as the men leave the ranks, and intervals are taken from him. The other lines are deployed at the discretion of the captain by similar commands.

To halt the lines the captain commands:

1. *First* (or *such*) *line.* 2. HALT.

The first line is accompanied by the first lieutenant, the second and third sergeants: the second line by the second lieutenant and the fourth sergeant: the third line by the fifth sergeant.

The reserve is under charge of the first sergeant.

The captain moves wherever his presence may be necessary; he indicates the disposition of the reserve.

If it is desired to cover more ground, the captain before deployment specifies the interval in yards and then commands as before.

3. Fire is opened by the first line without command. It is left to the discretion of the men when a shot can be made effective.

This rule is general.

4. As soon as the deployment is made, the file-closers take post where they can most conveniently and effectively superintend the lines they accompany. This rule is general.

From column of fours to the front.

5. At a halt or on the march the captain commands:

1. *First line front.* 2. MARCH.

At the second command the men composing the first line leave the column by the nearest flank and deploy as explained from line, covering ground equal to the original front of the company.

The centre skirmisher is designated as before, and the men leaving the company by the right flank form on his right, those by the left form on his left.

The other lines are deployed by the same commands as before.

The movement is completed as prescribed in paragraph 2.

From column of fours to the flank.

6. At a halt or on the march the captain commands:

1. *First line right* (or *left*). 2. MARCH.

At the second command the men composing the first line leave the column by the right flank and form on a front equal to the depth of the company in column, as explained from line.

The other lines are deployed by similar commands.

7. Skirmishers may be thrown to the front and on one or both flanks by commands:

1. *First line front—second line right* (or *left*). 2. MARCH.

or

1. *First line front–second line right–third line left.* 2. MARCH.

Executed as previously explained.

8. In all deployments the captain indicates to the chief of the reserve whether it shall be deployed or formed in line.

9. The men should be instructed:

In the early stages of an engagement not to fire except from cover and from a rest: to fire only when they are sure of hitting the object: to be continually on the move, taking advantage of all cover: to always move forward, and that it is when retreating the most severe losses occur.

10. The rifle should habitually be carried at a *trail*, this position being best adapted for the skirmisher to take advantage of cover quickly, as he can throw himself on the ground immediately after halting: he can also stoop while moving forward, thus presenting a smaller target to the enemy's fire.

To march in line.

11. The captain commands:

1. *First line* (or *such lines*) *forward.* 2. MARCH, or *double time,* MARCH.

At the second command the line or lines designated step off, dressing upon and preserving intervals from the centre skirmisher.

To halt.

12. The captain commands:

1. *First line* (or *such lines*). 2. HALT.

At the second command the line, or lines designated, halt.

To march to the rear.

13. The captain commands:

(1. *First line* (or *such lines*). 2. *To the rear.* 3. MARCH.

At the command, *march,* the men composing the line or lines designated, face about and march to the rear, dressing upon and preserving intervals from the centre skirmisher.

The line or lines marching to the rear, are halted by the same commands as when marching in advance: the men upon halting immediately face to the front.

14. Marching to the rear, to march to the front, the captain commands:

1. *First line* (or *such lines*). 2. *Forward.* 3. MARCH.

At the third command the men composing the line or lines designated, face about and march to the front.

RALLIES.

15. Skirmishers are rallied when threatened by bodies of the enemy's cavalry; the rallies are made at a run; when ordered to rally, the bayonets are fixed at the preparatory command.

The rallies are by line or company.

By line.

16. The captain commands:

1. *First* (or *such*) *line* (or *lines*) *rally.* 2. MARCH.

At the first command, the centre skirmisher of the line or lines designated elevates his rifle, and all the skirmishers of that line rally on him, those to the right forming a semi-circle to his right and rear; those to the left complete the circle by forming a semi-circle to the left and rear.

The file-closers place themselves within the circle.

The officer present directs the fire in the most efficacious manner. If the enemy approaches too close, he charges bayonets and resumes the fire as soon as the charge is repulsed.

The reserve may also be rallied by command of its chief:

1. *Reserve rally.* 2. MARCH.

Executed as explained for the lines.

By company.

17. When all the lines are merged, the captain commands:

1. *Company rally.* 2. MARCH.

Executed as explained for the lines, the captain and file-closers placing themselves in the circle.

The fire is directed and the position of charge bayonets taken as already explained.

To deploy.

18. The danger past, the captain commands:

1. *Deploy.* 2. MARCH.

At the first command, the skirmishers unfix bayonets, and at the second, moving at a run, resume their proper places.

The assembly.

19. If not more than two lines are deployed, the captain commands:

1. *Assemble on company.* 2. MARCH.

At the second command the line or lines deployed approach the company, and the men resume their places in line or column.

If more than two lines are deployed, the captain commands:

1. *Assemble on first* (or *such*) *line.* 2. MARCH.

At the second command, the line designated stands fast, the other lines approach and line is formed by the men closing toward the centre, without regard to their original places in line.

Fours are then counted.

20. After deployment all commands are repeated by the file-closers. This rule is *general.*

BATTALION BATTLE TACTICS.

21. The battalion is formed in single rank as at present prescribed.

To deploy the battalion from line.

22. At a halt or on the march, the colonel commands:

1. *First line front.* 2. MARCH.

Executed in each company as prescribed.

The other lines are deployed at discretion of the colonel by similar commands.

The lines are halted at command of the colonel:

1. *First* (or *such*) *line* (or *lines*). 2. HALT.

23. All commands are repeated by the captains and file-closers of lines deployed. This rule is *general.*

24. The first line is accompanied by the lieutenant-colonel; the major commands the reserve; the colonel goes wherever necessary.

From column of companies.

25. At a halt or on the march, the colonel commands:

1. *Right* (or *left*) *front.* 2. MARCH.

To the first command the captain of the leading company immediately adds, *first line front*, and repeats the command *march.*

Executed as prescribed in company tactics.

The captains in rear, to the first command, immediately add, *fours right* (or *left*), and repeating the command, *march*, move their companies by the flank until opposite their intervals in line, and then command:

1. *Fours left* (or *right*). 2. MARCH.

and immediately

1. *First line front.* 2. MARCH.

and halt the skirmishers on the line of skirmishers of the leading company. The balance of the movement is executed as already explained.

The other lines are deployed at command of the colonel:

1. *Second* (or *such*) *line front.* 2. MARCH.

Executed as explained in company tactics.

From column of fours.

26. At a halt or on the march, the colonel commands:

1. *Right* (or *left*) *front.* 2. MARCH.

To the first command, the captain of the leading company immediately adds, *first line front*, and repeats the command, *march.*

Executed as prescribed in company tactics.

The captains in rear, to the first command immediately add, *forward, column right* (or *left*) or, *column right* (or *left*), according as they are at a halt or on the march, and the movement is completed as prescribed (paragraph 25).

27. The colonel may designate certain companies to execute *right front*, and others to execute *left front*, when the captains of the designated companies give the necessary commands to execute the movement as previously explained: or he may designate certain companies to cover the right flank of the battalion, and others the left flank, when the captains immediately give the necessary commands to execute the movement by the shortest lines.

The first line only is deployed unless otherwise directed by the colonel.

28. *To march in line.*

To halt.

To march to the rear.

Executed by similar commands and means as in company tactics, the centre skirmishers preserving a general alignment.

RALLIES.

29. The colonel commands:

1. *First* (or *such*) *line* (or *1st, 2d, etc., lines*) *rally.* 2. MARCH.

Executed in each company as explained, the colonel and field officers placing themselves in the nearest circle.

To rally the reserve, the major commands:

1. *Reserve rally.* 2. MARCH.

Executed in each company as prescribed.

30. If all the lines are merged, the colonel commands:

1. *Companies rally.* 2. MARCH.

Executed by each company as prescribed.

To deploy.

31. The danger past, the colonel, or officer in immediate charge, commands:

1. *Deploy.* 2. MARCH.

Executed as prescribed.

To assemble.

32. If not more than two lines are deployed, the colonel commands:

1. *Assemble on company.* 2. MARCH.

Executed in each company as prescribed, and line formed by closing toward the centre of the battalion: or the companies are conducted to their places in column.

33. If more than two lines are deployed, the colonel commands:

Assemble on first (or *such*) *line.* 2. MARCH.

Executed in each company as prescribed, and line or column formed as before.

ARTILLERY SERVICE IN THE WAR OF THE REBELLION.

By BVT. BRIG.-GEN. J. C. TIDBALL, U. S. Army.

(*Continued from* Journal *No. 53.*)

III.

THE last paper closed with the ending of the Antietam campaign of the Army of the Potomac; and at that period of time when the latter had reached Warrenton, Va., moving in the direction of Richmond by skirting the eastern base of the Blue Ridge. Lee's army, skirting the western slope of the mountain, up the Shenandoah Valley, moved in the same direction. It was expected that the two armies would come together for a decisive battle somewhere in the vicinity of Orange Court House.

The Army of the Potomac, now commanded by Burnside, consisted of eight corps: viz., The First, commanded by John F. Reynolds; Second, by Couch; Third, by Stoneman; Fifth, by Butterfield; Sixth by "Baldy" Smith; Ninth, by Wilcox; Eleventh, by Sigel; and Twelfth, by Slocum.

The Eleventh Corps had been left to guard the approaches to Washington from the direction of the passes through the Blue Ridge from the Shenandoah Valley, and the Twelfth to guard the Upper Potomac at and near Harper's Ferry. The remaining six were organized into three "Grand Divisions,"—the Right, the Left and the Centre, commanded respectively by Sumner, Franklin, and Hooker. The Right consisted of the Second and Ninth Corps; the Left, of the First and Sixth; and the Centre of the Third and Fifth.

The cavalry division was commanded by Pleasanton. The artillery consisted of 373 pieces, including 24 of the horse batteries and 8 siege pieces.

The Artillery Reserve, which had received fostering care from McClellan, and which had done him such good service, was now under command of Colonel William Hays, and consisted of 18 batteries, of 88 guns, including the 8 siege pieces and the four

batteries of horse artillery. This left 51 batteries, of 285 guns, distributed in the usual manner to infantry divisions,—from two to four batteries to each division. For the command of all this artillery, equal in magnitude and importance to an army corps, there were but one brigadier-general (the chief of artillery of the Army); three colonels; two lieutenant-colonels, and two majors.

The cavalry, consisting of 15 small regiments, was organized into three brigades and constituted a division under Pleasanton. Mention was made in the preceding paper of the activity and of the gallant service of the cavalry and horse batteries in guarding the right flank of the army as it skirted along the Blue Ridge, and until the main body took position opposite Fredericksburg. After this, until the opening of the following spring campaign, the cavalry had little other than outpost and picket duty to perform, which, however, was extremely harassing. In this the horse batteries fortunately had no share. Artillery in the Fed eral Army was seldom employed in outpost duty,—not so much in fact as it should have been.

Burnside, upon taking command of the Army of the Potomac, was instructed by the War Department to continue the programme laid out for McClellan, and which the latter was pursuing when relieved; which was, to hug closely to the Blue Ridge with a view of forcing the enemy to battle by intervening between him and Richmond. Burnside, however, favored the more direct route to Richmond via Fredericksburg, and submitting his views to the President received from him a reluctant assent to try it. On the following day, (Nov. 15, 1862) he put his army in motion for Fredericksburg, opposite which Sumner arrived on the 17th. Burnside expected a pontoon train to arrive at the same time, to enable Sumner to cross without delay and seize upon the heights behind the town. But, owing to awkward delays, the pontoon train was not there, and in fact did not arrive until the 25th. In the meanwhile, Lee, divining Burnside's intentions, moved rapidly and occupied the opposite side of the Rappahannock but a few hours after the arrival of Sumner. Thus the opportunity was lost which Burnside had relied upon for success. Still adhering to his purpose of moving through Fredericksburg, he conceived the project of crossing the river directly in front of the enemy, and of driving him from the strong position he now held on the heights immediately in rear of the town. Burnside's method, or rather want of method, of carrying out this project

was so faulty, and as it turned out, so uselessly bloody, that it is refreshing to refer to any part of it not subject to adverse criticisms. This was the part enacted by the artillery.

Fredericksburg, a substantially built town of about 5000 inhabitants, is situated at the head of tide-water on the Rappahannock, at the point where it emerges from a ridge of hills which runs back of the town almost parallel with the course of the river. This ridge is terminated about five miles below the town by the narrow valley of the Massaponax Creek, a tributary of the Rappahannock. Between the river and the foot of the ridge the land is slightly undulating and ascending. The town stretches along the bank of the river for about a mile and a half, and back toward the ridge for about half a mile. Between the town and the ridge, and parallel with the river, is a canal, crossed by three wooden bridges. This canal formed a troublesome obstacle to the troops as they advanced to storm the ridge. Beyond the canal, at the foot of the ridge, runs a road which, for some distance, has a stone wall on either side of it; that next the hill being a sustaining wall for the sloping grounds in front of the Marye mansion which stands back upon the ridge, giving to this part of it the name of Marye's Heights. The wall upon the other side of the road had been strengthened by earth, and formed a secure parapet for infantry, over the heads of which successive lines in rear, one above the other in rifle trenches on the ascending slope of the heights, could fire with safety. These walls proved an insuperable obstacle to the advance of the Federal troops. None got beyond them. All of the valley, from the town down to the Massaponax, is open farm land, with here and there a group of farm buildings with orchards about them. The upper end of the ridge, or that directly back of the town, is cleared, but towards the Massaponax it is wooded, with the woods extending somewhat into the valley.

This wooded part of the ridge and valley was occupied by Jackson's Corps, which was attacked by the left wing under Franklin.

The Confederate Army occupied the entire ridge from the river above the town to the Massaponax, a distance of about five miles. The valley of the Massaponax from the ridge to the Rappahannock, a distance of about two miles, was held by Stuart's cavalry and his horse batteries. Longstreet's Corps held the left of Lee's line—that portion of the ridge behind the town, embrac-

ing Marye's Heights. Under the diligent labor of the Confederate troops the ridge grew into a formidable line of redoubts, batteries and infantry epaulments, covered in front by abattis and every device known to engineering skill. Lee had 66 batteries of about 264 guns, of which not less than 200 were in position on the ridge, while the remainder were near at hand for such service as might be required of them. In support of this formidable artillery he had upwards of 78,000 infantry *present for duty*. It was across this river, and over this low ground, and against this formidable rampart, that Burnside decided to hurl his brave army. The river at this part of its course is about two hundred yards wide, and being unfordable was to be crossed only by pontoon bridges. On the northern side of the river, occupied by Burnside, the land is high and rolling, and is known as the Heights of Stafford. The undulating brows of these heights along the river afforded many excellent positions for artillery, commanding with its fire the entire ground in front of the ridge upon which Lee was posted. With rifles, most of the ridge could be reached also. The chief portion of Burnside's army was far enough back upon the Heights to be out of view from the enemy. Lee had most of his infantry encamped at convenient points several miles distant, and so situated as to guard against flanking movements of his adversary, but all within easy supporting distance of each other.

While many changes had taken place among commanders in the Army of the Potomac, including the head of it, but few had been made in the Army of Northern Virginia. Lee still commanded it, with Longstreet and Jackson as his trusty lieutenants, and Stuart as his commander of cavalry. There was no change in his system of organization, which was that of two large corps, with heavy divisions and moderate sized brigades. His regiments averaged in number of men about the same as in the Army of the Potomac. His artillery system was the same as at Antietam ; that is, it was organized into battalions of from four to six batteries to a battalion, each of which was commanded by a colonel or lieutenant-colonel, while each two or three batteries were under majors. Each division of infantry had one of these battalions attached to it, and each corps had a reserve of two battalions. In addition to all this there was an army reserve of four battalions. The chief of artillery was a brigadier-general. It will thus be seen that the principle of rank somewhat commensurate with command was recognized as much for artillery as for other arms of service.

In the Army of the Potomac there was, with the exception of the Artillery Reserve, no organization of artillery higher than that of the battery; these, however, were of the highest excellence, and individually made up in a measure for what was lost for want of proper organization.

Burnside's army on the morning of the battle (December 13) numbered 113,000 for duty, of which about 80,000 crossed the river. When it was determined to make the attack directly across the river against the front of Lee's position, all of the available artillery was posted upon the projecting bluffs of the Heights of Stafford in order, as stated by General Hunt, chief of artillery: "to control the enemy's movements on the plain; to reply to and silence his batteries along the crest of his ridge; to command the town; to cover and protect the throwing of the bridges and crossing the troops, and to protect the left flank of the army from attacks in the direction of Massaponax Creek. For this it was necessary to cover the entire length with artillery posted in such positions as were favorable for these purposes." All the artillery, except one battery for each division, was withdrawn from the corps, and temporarily attached to the Artillery Reserve, and all arranged into four divisions. The right division, under Colonel Hays, consisted of 40 rifles, including six 20-pounders. The right centre, under Colonel Tompkins, consisted of 24 rifles and 14 Napoleons. The left centre, under Colonel Tyler, consisted of 27 rifles, of which seven were 4.5-inch, and eight were 20-pounders, the rest being 3-in. guns. The left division, under Captain De Russy, consisted of 44 rifles, of which eight were 20-pounders, and the remainder 3-inch. Altogether there were about 149 guns thus posted. Eighteen batteries,—about 100 guns, chiefly Napoleons,—remained with the infantry divisions; and in addition there were four horse-batteries of six guns each for cavalry service, making a grand total of 273 pieces thus disposed of. Hunt's instructions for the operations of each of these divisions of batteries, so full, clear and practical as to be a model for all such operations, were carried out to the letter.

The batteries of each division were stationed near their respective places, but kept out of view of the enemy until the night preceding the laying of the bridges, when they were brought forward and each posted in its appropriate place. The crossing was to be effected at three bridges: two in front of the town and the other about two miles still further down the river.

Subsequently a fourth was placed near this last. The enemy occupied the town in considerable force, and resisted the laying of the two upper bridges until six batteries of Napoleons were brought down and so riddled the houses as to drive out all except a few sharpshooters who, screening themselves in cellars and behind strong walls, still prevented the laying of the bridges. Finally the pontoons were filled with infantry, who, rowing across, soon silenced the fire of the sharpshooters, and the bridges were laid without further delay. At the lower crossing five batteries were brought down to the river and speedily drove away the enemy, thus permitting the bridge to be put down without further trouble. It was not the policy of Lee to resist the Federal troops at the crossing, or upon the plain in front of his fortified ridge, where his troops would be exposed to the fire of the numerous artillery from the Heights of Stafford. The slight resistance was, as he states, merely to gain time until he could get his troops into position behind his intrenchments on the ridge.

The bridges were laid on the forenoon of the 11th of December. On the following morning, covered by a dense fog, the Right Grand Division, under Sumner, crossing at the upper bridges, occupied the town, filling its streets with infantry, artillery and ambulances. Franklin crossed his Left Grand Division at the lower bridges, and formed line a short distance in front of the river. As the infantry divisions crossed the bridges they were rejoined by the batteries borrowed from them for the purposes before stated. In this way 19 batteries of 104 guns passed over with Sumner's command; but, it being manifest that so many could not find space there for employment, all except seven were recalled. Those remaining took a prominent part in the struggle of the next day.

Twenty-three batteries of 106 pieces crossed with Franklin, and this being in open ground there was ample space for all of them. The development of the attacks on this flank was such as to give active employment to all, and some of them were severely engaged.

Hooker's Grand Division—the centre—was used as a feeder for the other two. To Franklin was given Birney's and Sickles' divisions of the Third Corps. Bayard's cavalry brigade also crossed with Franklin.

As the battle progressed, and it was found that Sumner was

making no headway against the formidable obstacles in front of him, Whipple's division of the Third, and Griffin's, Sykes', and Humphreys' of the Fifth Corps were sent to him. These detachments absorbed about the whole of Hooker's Grand Division. One of Sumner's divisions, that of Burns, of the Ninth Corps, was with Franklin, making the total force of the latter amount to about 45,000 men ; that of Sumner numbered about 35,000.

The crossing was effected without much annoyance from the enemy, until about noon when the fog cleared away and the enemy opened a spirited though rather harmless fire of artillery.

By the time the crossing was completed the day was too far advanced for further operations, and the attack was postponed until the following morning. The troops bivouacked for the night on Lee's side of the river, Sumner's in and around the town, and Franklin's on the plain below. The latter established his line of battle, extending from Hazel Run, a small tributary of the Rappahannock near Lee's centre, to within a few hundred yards of the Massaponax Creek, a distance of nearly three miles. The right of his line was held by the Sixth Corps, the left by the First. Birney's and Sickles' divisions of the Third Corps, and Bayard's cavalry brigade were massed in rear of the First Corps. Burns' division of the Ninth was nearer the river, guarding the crossing.

Franklin says: "The enemy had artillery on the hills and in the valley of Deep Creek, in the wood near Reynolds' right, and on the Massaponax, so that the whole field was surrounded by it except on the right flank. His infantry appeared in all directions around the position."

A space of a mile or more intervened between Franklin's right and Sumner's left. For the security of this flank Captain Ayres, chief of artillery of Smith's Corps, posted 28 guns, which battery was prolonged by other groups of guns to the extreme left of Franklin's line where a number of batteries were stationed by Colonel Wainwright, chief of artillery of the First Corps.

Although the batteries of Franklin's command were attached in the usual way to divisions, the management of them in this battle was intrusted to Colonel Wainwright and Captain Ayres, the chiefs of artillery of his two corps, and were thus enabled to perform such excellent service as to elicit praise even from the enemy. They were held well in hand, and time and opportunity was not lost in hunting them scattered about with divisions or

brigades. They were always available where most needed. Jackson in his report says: "The artillery of the enemy was so judiciously posted as to make an advance of our troops across the plain very hazardous." This he gives as a reason for not having followed up the repulse which he gave to part of Franklin's command.

Jackson confronted Franklin with the 94 regiments of his own corps together with Hood's and Pickett's divisions of Longstreet's Corps, altogether 137 regiments.

Franklin had the 94 regiments of his own Grand Division, together with the divisions of Birney, Sickles and Burns of Sumner's and Hooker's Grand Divisions, in all 143 regiments. Franklin had a few regiments of cavalry under Bayard, but Jackson had a much greater number under Stuart; so that in number of regiments, which is a pretty fair gauge of the number of men, the two forces were about equal. In artillery, too, Franklin and Jackson were about equal: the former took over with him 23 batteries of 106 pieces; the latter had about 50 pieces acting with his troops, together with a group of 24 pieces near Deep Run on his left; another of 15 pieces near his centre and another of 14 pieces under Colonel Walker on his extreme right. These latter performed excellent work in repelling Franklin's attack. Stuart had a dozen or more pieces with his cavalry, and was exceedingly active with them against Franklin's left. In all, Jackson had about 115 guns.

That portion of the ridge occupied by Jackson was more broken and wooded than that held by Longstreet. The woods were dense and tangled, and extended a considerable distance into the plain in front of Franklin's left. It was in every respect most favorable for the Confederates, giving them not only the advantage of command from the ridge, but cover from the woods. Confederate soldiers were better bushwhackers than those of the Federal Army, and were therefore superior to them, man to man, in the woods.

Burnside had now, on the evening of the 12th, nearly all of his fighting strength safely in position on Lee's side of the river, but was evidently undecided as to what next to do. He apparently understood the hopelessness of attempting to carry Longstreet's part of the ridge by direct assault, but he did not seem to comprehend the advantage that might be gained by moving Sumner, during the night, to the left, and there, joining him with

Franklin, making a powerful attack upon Lee's right, with a view to crushing it in before it could be reinforced from the left. He, however, decided to assault Marye's Heights, and also attack Lee's right, and about 7 o'clock on the eventful morning of the 13th sent Franklin an order to attack without delay.

The order was ambiguous and confusing, but as well as Franklin could interpret it, he was to attack with one division, to be supported by another. He accordingly sent in Meade's Division, but, to be on the safe side, supported it by the other two of Reynolds' Corps—those of Doubleday and Gibbon. Preliminary to the attack a heavy fire of artillery was opened upon the woods in hopes of developing the position of the enemy, but without effect. Meade's Division moved steadily to the assault. Jackson says of this advance: "Walker (commanding the fourteen-gun battery on a knoll on his extreme right) reserved his fire until the enemy's lines came within less than 800 yards, when the fourteen guns opened, pouring such a storm of shot and shell into his ranks as to cause him first to halt, then to waver, and at last seek shelter by flight."

The division thus forced to retire was soon rallied and again advanced, this time with the division of Gibbon on its right. Of this second advance Jackson says: "About 10 o'clock the main attack was made by a rapid and heavy discharge of artillery. Under the protection of this warm and well-directed fire, his infantry in heavy force advanced, seeking the partial protection of a piece of woods extending beyond the railroad. The batteries on the right played on their ranks with destructive effect. The advancing force was visibly staggered by our rapid and well-directed artillery, but soon recovering from the shock, the Federal troops, consisting of Franklin's Grand Division, supported by Hooker's Grand Division, continued to press forward. Advancing within point-blank range of our infantry and thus exposed to the murderous fire of musketry and artillery, the struggle became fierce and sanguinary." He then describes with minuteness how his own lines were broken at certain points, and how restored, and how Franklin's lines were finally repulsed after a struggle so severe and sanguinary as to call for nearly all of his troops.

The divisions of Meade and Gibbon, becoming somewhat separated as they advanced through the thick wood, left a weak place in the line. The enemy discovering this, immediately took advantage of it and forced back these divisions. At this moment

Birney's Division of the Third Corps was put in "and drove the enemy from the front of the wood, where he had appeared in strong force. This division, with the aid of the artillery, soon drove the enemy back to shelter, and he did not again appear." Sickles came up with his division and assisted to hold the enemy back.

All of this time Smith's Sixth Corps was deployed in line of battle on the right of where the fighting was going on, and with the exception of its batteries, was comparatively idle. The batteries engaged those on the ridge in front of them.

While the battle was in progress in the woods, in front, the enemy made a serious demonstration on Franklin's left. This was met by Doubleday's Division, and the batteries Wainwright had assembled on that flank, greatly assisted by De Russy's artillery on the opposite side of the Rappahannock.

Nothing further was done on this part of the line. Burnside appears to have had no plan for Franklin to carry out, and he carried out none. Not one-half of his troops were engaged to amount to anything. On Jackson's side the division of D. H. Hill did not, in the language of Hill, "pull a trigger." But the troops of both sides that were engaged, were engaged fiercely. Franklin lost 528 killed, 3525 wounded and 811 missing, chiefly captured; total 4864. Jackson reported his loss at 344 killed, 2545 wounded and 526 missing; total 3415. His more advantageous position accounts for the difference in loss.

The fighting upon the right, where Sumner attacked Longstreet, was altogether of a different nature; scarcely a man of the troops of the latter left the cover of his intrenchments, and the attacks of Sumner were confined to the most desperate efforts to scale the ridge and get possession of the formidable earthworks lining its crests. Burnside's orders to Sumner were so confusing that it was not until about noon that he moved forward to attack. He too, like Franklin, was ordered to attack with one division supported closely by another. French's Division of the Second Corps was selected as the leading column, and boldly debouched from the town by the three streets leading to the bridges over the canal before mentioned. This canal proved a great and unexpected obstacle, causing the division to defile slowly over the bridges, from one of which the planking had been removed, thus forcing the men to cross on the string-pieces, all the while exposed to a concentrated fire from the artillery on the ridge, and

musketry from the rifle pits and sunken roads. French deployed his division and most gallantly moved forward to the assault. The fire, now concentrated on it, literally tore it to pieces; but sheltering themselves as much as possible behind slight inequalities of the ground, the regiments doggedly held what they had gained. French's Division was closely followed by that of Hancock, which underwent the same experience. The attacks from both were made by brigades with a view chiefly to get possession of the wall skirting the road. Hancock says: "Each brigade advanced in succession, under a most murderous fire of artillery and musketry; the artillery fire reaching the troops in a destructive manner in the town even before they had commenced the movement." The distance to overcome, by the way the troops were obliged to march before reaching the enemy's works, was probably 1700 yards; and it took an unusually long time to advance that distance in consequence of the canal, fences, and other obstacles.

The divisions of French and Hancock were then formed into one line, which they continued to maintain until after dark, and after the troops had exhausted their ammunition, and after the ammunition of the killed and wounded within reach had been expended. Howard's Division of the same corps then followed Hancock's, but met with like fate. Then those of Whipple of the Third, and Griffin and Humphreys of the Fifth Corps, were sent in, in the same manner, but without advancing the attack a pace beyond the ground gained by French and Hancock. Humphreys' was the last attack made. When all before it had failed, Burnside ordered Hooker to lead in his two last divisions—those of Sykes and Humphreys. Hooker remonstrated against this as being useless slaughter, but, being ordered peremptorily to do so, he first brought to bear upon the enemy as much artillery fire as possible in hopes of shaking the enemy at that point, and then sent Humphreys forward to attack with the bayonet. This attack was made with a spirit and determination seldom, if ever, equalled in war, Humphreys, himself, was simply heroic. But the impregnable position of the enemy gave such great advantage that the attack was almost immediately repulsed.

Humphreys' charge was made about sundown, after which the troops remained, holding the ground under the murderous fire of the enemy until recalled a few hours later.

Longstreet, in his report, describing these attacks says: "The

batteries had hardly opened when the enemy's infantry began to move towards my line. Our pickets in front of the Marye house were soon driven in, and the enemy began to display his forces in front of that point. Our artillery being in position, opened fire as the masses became dense enough to warrant it. This fire was very destructive and demoralizing in its effect, and frequently made gaps in the enemy's ranks that could be seen at the distance of a mile." It was evident that the defenses of the enemy were too powerful to be taken by an assault of infantry.

The seven batteries that took part in these assaults, boldly followed up the infantry, and, while doing their utmost, shared the same fate. Some of them met with unprecedented loss in men and horses. The nature of the ground was such that the artillery could give but little assistance to the infantry.

Of this attack by Sumner, Lee in his report says: "All the batteries on the Stafford Heights directed their fire upon the positions occupied by our artillery, with a view to silence it and cover the movements of the infantry. Without replying to this furious cannonade, our batteries poured a rapid and destructive fire into the dense lines of the enemy as they advanced to the attack, frequently breaking the ranks and forcing them to retreat to the shelter of the houses. Six times did the enemy, notwithstanding the havoc caused by our batteries, press on with great determination to within 100 yards of the foot of the hill, but here encountering the deadly fire of our infantry, his columns were broken and fled in confusion to the town."

The two divisions of the Ninth Corps remaining with Sumner, and forming the left of his line were not idle. These divisions were commanded by Sturgis and Getty, and were sent forward to storm the ridge, but with the same result as the others just mentioned.

Sumner's loss was 743 officers and men killed, 5368 wounded, and 958 captured, making a total of 7069, which added to that of Franklin gives a grand total of 11,933.

Lee lost 595 killed, 4061 wounded, and 653 missing, many of whom were captured, making a grand total of 5309.

The chief part of Lee's loss occurred in Jackson's command; that of Longstreet was comparatively slight, by reason of his troops being covered by intrenchments.

Lee's ordnance officer reports that 9091 muskets were collected from the field of battle. Comparing this with Burnside's

loss, it appears that but few of these could have been thrown uselessly aside by the Federal troops.

The attacks of Sumner and Franklin were entirely independent of each other; their troops did not unite towards the centre by half a mile or more. The attack of one did not serve even as a diversion in favor of the other.

It now became evident to Burnside that he could not succeed by proceeding in this manner, and having no other plan, his troops remained idle during the following day, and until after nightfall on the 15th, when they were all withdrawn, without molestation, to the north side of the river. Nothing was left behind but the dead, and those too severely wounded to be moved. The artillery brought away every gun and caisson. The batteries posted to cover the crossings remained in position until the bridges were taken up. The troops returned to their former camps, and thus ended the "Fredericksburg Campaign," the only creditable thing about which was the sterling soldierly qualities evinced by the troops; and the only useful thing, the excellent practical lesson given them in crossing a river in presence of an enemy; and in this the artillery was preëminent.

Burnside was relieved from the command of the Army of the Potomac soon after this, and Hooker assigned to it. The latter, during the winter, was energetic in bringing the army up to a high degree of efficiency, and towards spring began planning a campaign which culminated in his defeat at Chancellorsville on the three first days of the following May.

SOME PRINCIPLES OF ORGANIZATION ADAPTED TO THE CONDITIONS AFFECTING THE MAINTENANCE, INSTRUCTION AND EFFICIENCY OF OUR COAST ARTILLERY.

By LIEUT. SIDNEY E. STUART, Ordnance Dep't., U. S. A.

THIS paper embodies some ideas that have been entertained by the writer for several years, running back to the time when he was an officer of the artillery, and that sprang from his connection with that branch of the service. The peculiar importance of the subject at, and its appositeness to, the present time constitute the reason and apology for its production now. It may be well to premise that only the portion of the artillery intended for the coast defense is referred to in what follows.

In the artillery the peace footing should more nearly approach the war footing than in any other branch of the service, in respect both to the matériel and the personnel, to the preparation of the defenses and their armament, and to the number and training of the men. Our insular position, the numbers and character of our population, the extent of our material resources and the vastness of our territory, combine to warrant the statement that no nation or probable combination of nations could ever conquer us by invasion, or, I may add, if I apprehend aright the spirit of our people, except by invasion. It is not subjugation that we have to fear, but rather the immense material loss and the damage to our national honor and prestige which would most certainly result from an attack upon us while we are in a condition of unreadiness. The foe who is prepared will be tempted by the wealth exposed along our coast line to sudden attack, and will anticipate that rather than suffer such results we would yield our contention. And even in the event of war, a fortified frontier would serve as a screen behind which the volunteer armies for the defense of the country might be raised and organized. Should war come upon us, an efficient coast defense would therefore be our most probable and earliest need, and it demands a corresponding state of preparation and readiness.

As our subject relates to the personnel we need say of the matériel only that it is of a nature admitting of no improvisation; what is not prepared before the outbreak of hostilities may as well be left out of account, for it could not be prepared in time to be available against a ready adversary. In estimating the degree of efficiency that the personnel should possess we must also consider that the artillery is by far the most costly branch of the service in proportion to the number of men employed, both in respect to the first cost of armament and to the expenditure of matériel in action. A 12-inch steel rifle costs, with its mounting, in the neighborhood of $100,000, its armor piercing projectile about $500, and its powder charge about $125. It is certainly economy, viewed from a mere money standpoint, to provide for this costly service a well trained and thoroughly efficient force, and still more desirable does it appear to do so when the technical character of the service and the accuracy of manipulation necessary to obtaining good results are considered. Artillery produces but little moral and no physical effect except by hitting, and to secure a good proportion of hits requires a very considerable degree of technical efficiency only to be acquired by training.

Assuming then that the ratio of the peace footing to that of the war footing should be relatively high for the artillery, let us consider how large a force will be required to man our coast defenses in the event of a future war. The reorganization of these defenses has been begun, and bids fair to be continued to such a development as shall constitute a respectable defense of at least our principal seaports. According to the report of the Board on Fortifications or other Defenses, which seems to have been definitely adopted as the guiding plan in this development, land fortifications will constitute an important part of this defense, and already the construction of the emplacements and armament has been entered upon. The report of the Major-General commanding the Army for 1889 estimates that 52,000 men would be required for the efficient service of the present armament, while 35,000 more would be required for the new armament proposed by the board. Even the first of these figures is rather startling when compared with our present strength, and it serves to accentuate the gravity of the subject herein discussed.

The ratio of the numerical strength of the peace footing to that of the war footing is subject to the opposing considerations

of economy and efficiency. The solution adopted ought to secure at least a fair degree of the latter, but great weight must be given to the former, especially as the peace organization must be maintained for long periods of at least superficially apparent needlessness and the consequent hostile criticism.

It would appear then that the existing conditions demand of those entrusted with the national defense the solution of about the following problem: *What is the cheapest organization of the artillery adapted to the prompt creation by mobilization of an efficient artillery force of from 52,000 to 87,000 men?* It is hoped that the principles to be presented will commend themselves as suitable for use in attaining the desired organization.

With this brief presentation of our needs let us proceed to the enunciation of the principles which it is the special purpose of this article to advocate. They are four in number, and for the sake of convenience the statement of each will be immediately followed by its discussion.

1. *The peace organization, in both form and strength, should be based upon and definitely fixed in relation to the organization required in war, and the method of mobilization should be thoroughly planned in advance.*

This principle is so axiomatic as scarcely to need discussion or even statement. It is easily possible of execution, for the numbers and functions of the war footing can be calculated from the knowledge of the armament in position or capable of being promptly placed in position. Under this plan a sufficient number of batteries and officers, according to the basis for mobilization adopted, should be at once provided for the service of our present armament, and this force should be increased to keep pace with the increase of armament as fast as provided. The truest economy demands that we maintain neither troops without armament nor armament without troops for its service.

2. *The artillery should constitute a corps, the division of which into major and minor units for administration, instruction and tactical control should be founded on considerations of distribution, armament and sphere of operation.*

An essential difference between the coast artillery and the other branches of the line, that makes the regimental organization, although the best for them, quite unsuitable for it, is this: that its units are stationary portions of a stationary force, while theirs are movable parts of a force of which mobility is one of

the principal desiderata. For those arms of the service that are employed in field operations where the circumstances of their action change with each new occasion for their employment, the division into units of uniform size and organization is the best that the circumstances permit; but the quality of being stationary possessed by the coast artillery is a valuable one which is not taken advantage of by the, for it, purely artificial division into regiments, but can and should be by a natural division based on the circumstances of its distribution, armament and sphere of action, and which may be adjusted to the requirements of each particular case.

Such a division would be one into posts or garrisons, with subdivisions based primarily on the distribution in the various works or parts of the same work, and secondarily on the kinds and spheres of action of their armament. Thus, the troops defending each geographically distinct port or entrance would constitute a division of the first order, which we will call for convenience a brigade. For example: Portland, Boston, entrance to Narragansett Bay, eastern entrance to New York, southern entrance to New York, etc. The garrisons of the distinct works at each port would constitute divisions of the second order, or garrisons. Example; at the southern entrance to New York,—Fort Hamilton, Fort Wadsworth, Sandy Hook and perhaps others. These garrisons would be sub-divided into divisions of the third order, or battalions, arranged, in so far as distribution and the number of field officers available for commanders would allow, so as to give to each a single sphere of action and uniform or similar armaments. The division of the fourth order would be the battery, to which would pertain the same functions of administration and instruction as at present. The pieces served by it should always be contiguous, of the same kind, and designed to have the same sphere of action; and to meet these conditions the size of the battery might vary either way by a third or half of its normal strength. Probably not all of these units would be necessary except at the more important positions; thus, if there were but one fortification at the place, the brigade and garrison would be merged in one, and it would not be necessary to form battalions in small works.

Some such organization as the above would, if not planned beforehand, be improvised during war as the natural and only practicable way of securing tactical control in action, and before it,

any artificial division would be obliged to give way. It should then be adopted in peace.

To give this form of organization its full measure of effectiveness (supposing a definite plan of mobilization to exist upon which the peace organization is founded) the armament to be served should, when practicable, be divided into groups of such size as to require for the service of each the force resulting from the mobilization of a battery, and each peace battery should be assigned to the care and service of a group. Every member of the battery could then be made thoroughly conversant with the service and care of the piece, the preparation and service of ammunition, the ranges of the channel and other points within the sphere of action of the group of pieces that they would be called on to direct in action. This would enable them to attain to the greatest practicable efficiency in their special work, and being disseminated throughout the battalion formed by the mobilization of the battery, would give to it the best ratio of efficiency to time of preparation.

The officers should be transferable throughout the corps, and it should be the policy to give them service at the various ports and kinds of fortifications and armament in order to widen their professional training and increase their adaptability. The batteries and their enlisted personnel, however, should rarely, if ever, be transferred from port to port, though it would be well to transfer them from one group of guns to another at the same port occasionally. This condition is made possible by the quality of being stationary in service, and should be taken advantage of to make the service as little onerous as possible, for the sake of the resulting gain in the quality of men obtainable; it would be of particular advantage in the event of the adoption of the 4th principle to be enunciated.

3. *The intellectual standard of the enlisted men in time of peace should be such that suitable subaltern and non-commissioned officers for the war footing could be secured from them.*

As has been before set forth, the matériel that the artillery serves and expends in action is exceedingly costly and the interests to be protected are exceedingly valuable; correspondingly the quality of the personnel should be exceedingly good. Also, our large seaports would be the first and most valuable objects of attack and their loss of the greatest consequence to ourselves, and consequently the artillery especially should be capable of expansion

in the shortest time to an efficient war footing; if not able to repel the first attack it would be of no use afterwards. And, moreover, a high degree of technical training of the officers of all grades is necessary to the proper development of the offensive capacities of the modern accurate and powerful guns that will soon be found in our fortifications. These considerations warrant and demand that at least the commissioned and non-commissioned officers of the mobilized force should be of excellent and good mental capacity, respectively, well instructed in their duties during peace and held in readiness for immediate service at need. As the peace organization must allow for a large expansion by mobilization, it follows that the subaltern and non-commissioned officers of the war footing must be drawn from the enlisted force of the peace establishment, a condition that demands the adoption of the principle under discussion.

It cannot be said that this principle is fulfilled in the present state of the service. While we undoubtedly have many satisfactory men, the majority of them are below the standard demanded, nor is it probable that a sufficient number of the requisite quality could be obtained at the present rates of pay. The pay should be increased in proportion to the increase in capacity demanded, and then enlistments should be made only after a personal examination by an artillery officer of experience and excellent judgment. That the capacity demanded and the pay accorded should be higher in the artillery than in the other branches of the line, follows from the fact that in it the subaltern and non-commissioned officers of the war footing should be drawn from the enlisted force of the peace footing, while such action is not contemplated in them.

4. *A new class of enlisted men should be established in the artillery, the members of which should be recruited from the near vicinity of the post where they are to serve and required to give only a small portion of their time to the service, thus securing for them a fair degree of manual training without withdrawal from or serious interruption to their civil pursuits.* This I consider to be the most radical, as it is the most important of the principles presented for consideration.

In providing a force for the performance of the important and even indispensable functions pertaining to the artillery, true economy undoubtedly demands that the question of cost be largely subservient to efficiency. But as has been before said,

this force must be maintained through long intervals of peace in order that its services may be available in the rare event of war, if, indeed, the very existence of a fairly efficient force may not have such an effect as a *preventive* of war, that the occasion for its services in action would never arise. In such a case it is of great importance that in choosing among the various methods by which efficiency may be secured, the element of cheapness should receive a great deal of consideration. The cheapest way of providing an efficient force is the one to be selected, and it would seem to be apparent without demonstration that the cheapest way of providing that portion of the war quota that must have some training during peace and need have but little, is to impart this training in such a way as not to withdraw its members from or seriously interfere with the pursuit of their ordinary avocations.

The report of the Major-General commanding the Army, above quoted, estimates that 10 per cent. of the strength required for the service of the guns is sufficient for caring for them in peace; this is then the least number that should be permanently maintained. And while in no branch of the service does the officer of whatever grade require more special training for the proper performance of his duties, in no branch is less required for a large proportion of the privates. A large proportion of the work about the guns is manual labor that can be satisfactorily performed under intelligent supervision with but little previous instruction. Moreover, no manœuvring of bodies is required, and being sheltered by parapets in action, little disciplinary training is necessary to secure the requisite degree of coolness and *morale* for efficient service. Hence it would be possible to rely for the greater portion of the privates of the war footing on enlistment when the necessity of mobilization should become apparent. Nevertheless, it will hardly be supposed that a sprinkling of one trained man to ten uninstructed ones would be sufficient for leavening the whole, in the short time that we can rely on for preparation between the certainty of approaching war and the appearance of an enemy on our coasts. And especially will this be true of the more complex and heavier mounts, operated by power, that will be found in our new fortifications. It will be necessary, therefore, to provide a force, in excess of that required as caretakers, which shall be instructed during peace and held in readiness to assist these latter in the leavening process at the outbreak of war. Such a force would be naturally and satisfac-

torily provided by the operation of the principle under discussion.

The men of this class should be regularly enlisted in it and permanently assigned to batteries, of which they would form a regular component part, carried on the battery rolls for pay and allowances of subsistence and clothing incident to the service demanded. The battery commanders would then be charged with the discipline and instruction of this class, and, aided by their subordinates, should be able to make the most of the time allotted for attendance in service. The fact that the positions to be defended are very generally in the immediate vicinity of large cities is particularly favorable to this plan,—is, in fact, what makes it possible. By reason of this nearness the men could be trained in the service of the particular batteries or even pieces that they would be called on to serve in action, and at the expense of only an occasional half-day; and much of the instruction could be readily imparted in the evening in armories established for the purpose and used in turn by the batteries at the post. By this plan it should be possible to provide at a minimum cost a large and well-trained force that would admit of a sudden and great expansion while still retaining a fair degree of efficiency.

That this method possesses important advantages over that of relying on the militia of the States for the trained element of the portion added by mobilization seems hardly to admit of question. Under the latter it would be next to impossible to form a definite plan of mobilization in advance, and quite as difficult to obtain a well connected and perfectly controlled defense in the end. Moreover, militia officers could not, in the nature of things, possess the technical knowledge and training of the regular Army, which is necessary for the proper development and regulation of the fire in action.

But even if the militia plan were equally effective with that proposed, it is doubtful if it should be substituted for it. It is to be remembered that the defense of a city demands, in addition to the fortifications, a considerable movable body to prevent the enemy from taking it in rear by a force landed for the purpose. It is believed that all the militia of the States would be demanded for this purpose, and to assist in raising and organizing the armies that would be in the process of formation, and that, should it be depended on for the service of the fortifications, the artillery would in the event of war find itself deprived of the as-

sistance on which it had relied. Then again, the militia have not sufficient time at their disposal for the acquisition of proper efficiency in more than one branch of the service, while a purely heavy artillery militia would lack those elements of display and popularity without which no efficient State militia can be maintained, at least under the present conditions.

With a peace organization involving the principles advocated it would seem that the best way of making the expansion of mobilization would be to create from the material of each battery several new ones, distributing this material among them as officers, non-commissioned officers and trained privates. These new batteries should be provisionally formed on paper in time of peace, and the names of their officers, both commissioned and non-commissioned, definitely assigned. By this method the simple order for mobilization would require to be supplemented only by the enlistment in the neighboring city of a sufficient number of privates to fill up the batteries, which, being already provided with trained officers of all grades, and a sprinkling of instructed privates, could be made fairly efficient with a few days of drill. That the possession of such an organization and plan secures the elements of cheapness and efficiency, therefore of a true economy, in a high degree, is the belief that has incited the writer to the production of this article.

The following scheme of a battery organization, and the method of its mobilization is presented as an illustration of the operation of the previous principles, the last particularly. It assumes that they are engrafted on our present system, and represents, of course, only one of a variety of forms involving them and more or less well adapted for the attainment of the object in view. This scheme seems to the writer a good one, but it must not be considered that he advocates this, the form, with at all the same insistence or rigidity as he does the principles illustrated, the substance of the matter.

In this plan each peace battery constitutes the basis for the formation of three batteries by mobilization, and one-third of the enlisted force of the battery in peace consists of the ordinary class at present in vogue, while the remainder is composed of men of the special class above proposed. We will refer to these as the 1st and 2d classes, respectively. Thus, one-ninth of the entire war force would give continuous service in peace, furnishing the required force of care-takers, and one-third would be

trained in peace and ready to undertake the direction and supervision of the remaining two-thirds to be enlisted during mobilization. The enlisted strength of the battery should be as large as practicable, for the purpose of reducing the number of officers, an expensive element at best. For the purpose of illustration, it has been taken at about 110, assigning 1 duty sergeant and 2 corporals to 24 privates in peace, and adding one corporal in war when more supervision would be required. The size of the battery and the proportion of non-commissioned officers to privates should, however, be subject to variation and adjusted to the needs of the particular service to which it is assigned.

Organization of a battery in peace and war, showing method of expansion during mobilization.

	Batteries.	Captains.	Lieutenants.	1st Sergts.	Sergeants.	Corporals.	1st Class Pvts.	2nd Class Pvts.	Buglers.	Total Comm'd.	Total Enlisted.	Grand Total.
Peace	1	1	2	1	4	8	24	72	2	3	111	114
War	1	1	2	1	4	12	17	79	2	3	115	118
War	3	3	6	3	12	36	51	237	6			
Whence derived.		2 Lts., 1 1st Sergt.	4 Sergts., 2 Cpls.	3 Cpls.	3 Cpls., 9 1st Cl. Pvts.	15 1st Cl., 21 2d Cl. Pvts.	2d Cl. Pvts.	Enlistment.	2 Bugs., 4 Enlist.			

The original and other vacancies created by the expansion of mobilization should be filled by regular advancement from the lower grades. This would cause the promotion of practically all the captains, leaving this grade to be filled as is indicated in the table. The general effect of the mobilization would thus be that the commanders of the battalions in the mobilized force would be the former commanders of the batteries from which they were formed; the commanders of batteries would be the lieutenants and the best sergeant of the original battery; their subalterns the choice of its non-commissioned officers; and their non-commissioned officers its remaining non-commissioned officers, its 1st class privates and the best of its 2d class privates; leaving a

sprinkling of one instructed man to five newly enlisted ones as a leavening force. With such an organization in peace and a plan of mobilization fully matured, even to the names of the prospective officers of all grades, the mobilization could be effected very quickly and the mobilized force made efficient in a very short time, not to be counted by weeks but by days.

The 2d class privates should be enlisted for a short period only, say one year, and it should be the policy to enlist a considerable number of new men each year in order to gradually accumulate a reserve available for enlistment on mobilization, thus increasing, perhaps, to a large extent, the trained element in the mobilized force. It would probably be practicable to make all the enlistments at the same time, at the end of the open air drill season. Then the men of each battery should be required to report at an armory on a designated evening of each week for evening drill, to be conducted by the captain, assisted by a sufficient detail from the battery. The batteries at the post would use the armory in rotation, and it should be supplied with dummies for teaching the service of the piece, and with facilities for instruction in the preparation and service of ammunition and the use of all artillery implements. Here, also, the necessary setting up and marching drills would be given. Then, during the open air drill season, they should be required to give the afternoon instead of the evening, and a period of constant attendance of perhaps a week during the target practice season should be demanded. Care should be taken to make the service as pleasant and little onerous as possible, and to this end the hours and days of service should be specified in the enlistment papers. Absence without leave or valid excuse of sickness should work a loss of pay for two similar drills, and habitual absence should be ground for discharge after the stoppages should have absorbed the pay due. One half of the pay should be paid by the captain once a month, in order to make the reward of attendance immediate, but the other half should be retained to the end of the enlistment in order to secure a hold on the soldier tending to prevent absence after the novelty should have worn off. It would perhaps be well to recruit the 1st class privates from the 2d class.

Each soldier, when proficient in his own duties, should be exercised in those of the higher grades to which he would be liable to be called in war, and all the permanent force should be well instructed in range finding, signalling, and all other duties neces-

sary to secure the most efficient service of the armament. To give them time for this, for the instruction of the 2d class, and for the work involved in the care of armament, a lower priced force of civilian laborers should be employed under the quartermaster for the general police of the garrison, the repair of roads, slopes, etc., thus securing this work at reduced cost and increasing the attractiveness of the regular service to men of good abilities.

Let us examine in a general way into the relative cost of a soldier entirely withdrawn from civil pursuits, at the present rates of pay, and one of the 2d class proposed. From the report of the Secretary of War it appears that each soldier costs per year for subsistence, quarters, clothing, hospital attendance, etc., excluding pay and transportation of men and supplies, about $275; to which add the pay of a private, during first enlistment, about $175, we have $450.

For each 2d class private we would have, say,

30 evening drills, 1 drill per week, at	$0.75	$22.50	
21 afternoon " " " " "	1.50	31.50	
6 days continuous service . . . "	3.00	18.00	
Total pay			$72.00
21 suppers after afternoon drills at	$0.25	5.25	
6 days meals during continuous service at	$1.00	6.00	
Total-subsistence . . .			11.25
1 undress uniform, including rubber coat but not overcoat . . . . . Clothing			10.00
Use of C. & G. Equipage, Medicines, etc., . .			6.75
Total cost			$100 00

There would be also some expense for the transportation of the men to and from the afternoon drills, and for the armory, but this would, in part at least, be offset by the cost of transportation of troops and supplies not charged in the present cost above quoted. The pay of the permanent force would be higher than at present, but taking all into consideration it would appear that the cost of a battery under the scheme presented would be about the same as under the present organization, while it may reasonably be claimed that the efficiency of the new battery as a nucleus for expansion in war would be much greater than that of the

battery as now constituted and manned, and it would also be of value in establishing a trained reserve in each port.

In brief, the principles presented are, it is argued, well adapted under the conditions environing the artillery, to the production of an efficient force for the defense of our fortifications in war while presenting the maximum ratio of efficiency in war to cost in peace. That this argument will be generally concurred in cannot, of course, be assumed by the writer; and perhaps it is better that it should arouse hostile criticism, in order that by the adduction of a broader range of argument and opinion a clearer light may be thrown on the subject in which the true method may be the more easily discerned. The writer has observed instances of publications in the JOURNAL that proved to be more valuable for the criticism evoked than for their own merit. His earnest wish, in the interest of the service in general, is that this paper may have a similar fortunate result.

Comment and Criticism.

(The remarks under this head have, generally, been invited by the Publication Committee, which desires that, as far as practicable, these "Comments" should appear under authors' names.)

I

"The Summary Court."

Col. John Hamilton, U. S. Artillery (Retired).

THE article of Mr. Power in the July number of the JOURNAL is a fertile source of thought to the "Old Officer." Why couldn't the Army have had the Summary Court as well fifty years ago as to-day? The service demanded and needed it quite as much in the past as it does now. Some will say it was due to the indifference of the law-making power to our needs; others will believe it due to the presidential bee in the bonnet of some of our high officers. To these a lumbering court best proclaimed their zeal for the rights of the soldier.

There can be no doubt as to the improvement in the personnel of the enlisted force in the last fifty or sixty years. Some refer this amelioration not to orders, but to the increased facility of getting rid of the scurvy offscourings which in Old Army times had to be nurtured in the guard-house, and in cutting wood in the officer's backyard under the matronage of the cook.

Probably both causes have had their part in the betterment; or the truth may be that this last has prepared the army mass for the amelioration of that later administrational policy.

Our sympathies must go out to the Old Army officer. Government gave him such material as could be most cheaply floated in, and then treated the service as a penal colony for the reformation of the rejecta of civil life. Only the crudest possible means of discipline were given him and little by little everything like summary means of administering correction was taken from him; whether because of their abuse, or as was held at the time, the posing of the general administration as the "soldier's friend."

Beccaria's quoted apothegm like most excerpted things is certainly defective as a summary of penologic justice. There is no proper right inheres in a public to punish except as chastisement. If punishment be not sufficient to correct the abuse or prevent its recurrence, it is futile, and futile punishment is unauthorized. If it do not correct the wrong, it is not chastisement, it is simply revenge.

Hence a wise latitude is left in all laws, not simply looking to the grade of the offense, but also to the character of the offender. Why our own military law was so many ages behind that of other nations, and of our own civic-criminal practice in this latter point, is inexplicable. It is true that military courts, especially garrison courts, *acted* on it, but it was not permitted to appear in the "proceedings."

A city Recorder hears a police officer's report, "Your Honor, this man has been before this Court very often for this offense," and the Recorder, in view of the inefficiency of previous chastisements, puts on a heavy penalty.

But to avoid the entirely unjustifiable inference that the soldier is being tried twice for the same offense, a lumbering system of bringing the past acts to the attention of the Court has been reached tentatively, little by little, till the punishment is now equally shared by the culprit's captain in searching out, selecting, and copying the culprit's record.

Why not as in British practice, add a clause to the specification thus—[The third, or—— repetition of this offense of which the accused has been convicted within —— months]?

When the author touches on the subject of grading punishment to the offense, the *action* of Congress and the President is new, but the demand for it is very old. O'Brien in his *Military Laws and Courts-Martial* lays out a plan which army administration never advantaged itself of. But really it never received other than very qualified approval.

Have courts been accused generally of adjudging correction beyond the measure of offense?

It strikes one as strange that it has taken from 1846 to 1890 to act on O'Brien's proposition, and then only by a congressional act. If the views set forth further on are founded on historic law, the limiting of punishment was always in the hands of the Executive.

The amount of punishment formerly accorded to desertion has been more modified by administrative action than any other, probably. The old court placed its punishment on the ground that it was not just that the deserter should profit by his desertion to escape his full period of enlistment. The reason why modern reductions have been made is not so clear; because humanity and charity have improved; because the offense is not as great as it was; because the percentage of desertion has decreased; because the capacity of Fort Leavenworth is not equal to the necessities; because the instruction there makes a good boy of the deserter in two or three years, and fits him to live in good society? All of these may be true, still the well-known and frank predicate of the old court stands unsmirched as a question of justice, according to the old officers' idea of Loyalty to the Colors. Legislation now has fixed that Loyalty to the Colors doesn't count, if the deserter can dodge them for two years.

A much more important and more difficult question of administration would be to equalize the action of courts. At the same post two differently constituted courts will adjudge very different punishment for the same offense. The discretion of the reviewing officer may tend to equalize these discrepancies measurably, if he be *easy;* if he is a "hard" man the discrepancy stands.

This brings us to the really important part of the author's article—His translation of the act of October 1, 1890, as regards its limiting the power for mercy of the commanding officer.

By this translation we now have an uncorrectable difference between "second officers'" punishments.

Or, is it expected that such an understanding shall exist between the second officer and his commander, that the behests of the second officer will be agreeable to the commander's mercy, or is it to be understood henceforth that the second officer runs this post "and that the commanding officer has little influence in the administration"?

It is believed that a full view of the whole ground would not sustain the author's translation of the act.

The thoughts and intentions of the framers of the act, the opinions and reasoning researches of the legislative committee which revised it, or the thoughts or want of thoughts of the legislators who voted it into life have not been placed before the public. Hence, the law is to be translated according to its wording—to its connection

with like laws—to the work it is to accomplish—and with regard to existing principles of administration. The power of military punishment preceded all law. As the chastisement of the child inheres in the father, so did punishment adhere in the commander in the field. All military history shows that all authority for punishment emanates from him—has no legal force but through him—and he holds the power to delegate so much of his authority as he may choose. As governmental society began to take form, and the immediate commander was not majesty, the right of the subject began to be protected against the whims, caprices, violence—limited knowledge of the commander. Advisory courts were instituted as the proper check. They have no force otherwise. They simply state the degree of punishment which the commander shall not exceed. The punishment comes from the imperator, the Cæsar in the field. To take from him all powers of mercy, all powers of cautionary danger to the culprit, beyond the obligatory legal condemnation by a court, would, as our cousins over the water say, appear to be a bit laughable. To bring about such a solecism in law—in administration—in the history of the human race, would require more than the mere omission of words from an act, which words should go *sans dire* in the minds of men imbued with true notions of the source of authority.

Let us lead up. Majesty was the captain in the field, first. It was law. Then, majesty was needed at home, to govern. It delegated its authority to the captain in the field. The captain abused his authority, or acted in ignorance of all the facts. Majesty, to protect the subject, instituted the court, to assist, investigate the facts, advise and limit him the captain. Certain'y never to rob him of his power of mercy, thus transferring the subject to the inflexible tyranny of a court. Nor was the captain reduced to the dilemma of letting the culprit go scot free in order to snub the court.

In the beginning of our peculiar form of national government, the people were so jealous of their rights that in framing our Constitution they feared that any undeclared right would be considered a reserved right. The constitutional right of pardon given the President was not a new thing given, but it secured to him a right preëxistent in sovereignty, and its declaration in the Constitution was simply a precaution against any claim that constitutional silence might deny it to him under our peculiar form of government. For a similar reason, to avoid an improper inference from the very specificness of the duties of all, as set forth in our Articles of War, to preserve the rights of mercy through the reviewing officer, beyond quibble, the 112th Article of War was introduced. It was so developed as to include all courts known at the time. Had it used only the word "courts," men would have been found to translate this as referring only to general courts.

In process of time another court, the Field-officer's, was injected into the system under substantially the same terminology of revision now used in the law for the summary court. Nobody ever thought that this deprived the brigadier of the right to modify the field-officer's sentence to the best advantages of justice and of the service. The law entered the Articles of War as the 80th, its revision was governed by Art. 110 and no fair mind, it is humbly believed, can make it independent of Art. 112.

Now, that this summary court has been launched by a special act, the author claims that Art. 112 has no bearing on it. Yet it shows itself to be a connected part of a sequence of jurisprudence, involving like machinery, genesis, supervision, and calling on the same vitalizing power to give its behests effect.

It is hard to believe that one vote could be got, in any American legislative body, for the creation of a court which deprived the convening officer of the right to exercise his judgment in the way of mercy or prudence in amelioration of sentence.

Heretofore, if a reviewing officer set aside the decision of a court, it could not be construed personally. In this new court, it can but be directed against the opinion of

the second officer. This is a grave objection to the law as translated. The tendency will be in one of two directions: either to set the two authorities (the writer's translation of the law makes the second officer an authority) by the ears, or to make the second officer first ascertain what in each case will be pleasing to the commander.

We say tendency: these results will not necessarily follow, for prudent judgment in administration may rob a very vicious law of much of its hurtfulness.

"For forms of government let fools contest;
That which is best administered is best."

If by the word "approval" in the law, the author can take from the commander the power of mitigation, does he not take the same power from the Commander-in-Chief of the Army and Navy? The field-commander held the right by delegation from the imperator before any legislation was attempted in matters of punishment. Does not the law intrude on executive prerogative?

Will not the same rigidity of translation take from the commander all discretion as to the propriety of arraigning the man?

Somebody makes a "charge"; by the word of the law the commander is forced to place the accused on trial, whether the case be necessary or not, in his judgment. Where, in his judgment, a good reproof would answer a better purpose, the *letter* requires that all enlisted men *charged* with offenses *shall be* tried. If this be not a sweeping intrusion on the previous honored right of judgment of an administrative officer, what shall we call it?

But is it not that the fault lies in the author's system of translation? Taking the law as a thing in itself, discrete from all rules governing like creations, and denying its created court to be a simple part of the general jurisprudence of the Army? Allow it to be such part, introducing nothing new except what is specifically set forth, taking away no rights except those plainly denied, and the law is ready to enter into the Articles of War as a smoothly running adjunct to justice. Introduce it into the Articles of War *with the author's translation*, and we would have to make a new Article in violation of the spirit of the 112th. What Congressman would vote for such an article?

Again, why is it not imperative to publish the action of a summary court in orders? The culprit's captain has to have an authority for making stoppages against him, and the command has a right to get the *measurement*, the personal equation of the "second officers." The enlisted man has a right to know what he is to expect for a given offense, Paragraphs 901 and 907, A. R., would appear to apply to all imaginable courts which can confine, or stop pay.

Finally, the *reductio ad*, etc., is that if a man accepts trial by a second officer, he can get no mitigation through his commander, but should he claim trial by four officers, the second officer being the president of the court, the commander can mitigate as much as he pleases.

It passes credence that legislators should have so understood their Act.

II.

"Range and Position Finding."

Lieut. C. L. Best, Jr., 1st U. S. Artillery.

THE article on Range and Position topics appearing in the JOURNAL for July has turned thought into a good channel and brought disputants into the arena. At this time there is no theme more worthy of consideration by our artillerists than that bearing on future fire effect. Shall we, in our methods and capabilities, double time with the age, or keep busy resting ourselves?

Were our present heaviest guns grouped in threes, a group of such, complete in all

details and accessories, hardly accurate beyond 1500 yards and loaded by cannoneers exposed to machine-gun fire, would represent a value of some $70,000, a salvo costing $200. A group of 12-inch rifles which will be loaded, directed and elevated before being run up to fire, and accurate for several thousands yards – such a group would represent a value of $500,000 or more, and from it a salvo, war projectiles and wear of tube considered, would cost nearly $2000. Surely, the possibilities of such ordnance must not be frittered away if its work can be made to tell.

To accomplish this, three things stand out prominently as essential. 1st. That the object to be struck be accurately located. 2d. That such location be communicated to the firing point or points, promptly and by simple message. 3d. That by simple method gunners may lay their guns accurately.

Whatever may be the means to accomplish the ultimate result, it will be of small value unless the gun itself is a keen edged tool. Heretofore it has been our custom to take our powder, load the gun with the prescribed charge, elevate it according to table, fire away—and fall short. This method, an inheritance from the sailing vessel era, will not answer modern needs. Guns should not pass from the proving grounds with records for velocity (resulting from a powder chamber crammed with the freshest powder) that they can never know again. A little margin should be left, that at subsequent times, when stored powder has lost its fresh strength, the charge can, within safe limits, be so increased as to secure what we may call the *standard velocity*—each calibre its own, of course. In this way, and only in this way, can we be assured that when the gun is elevated as per table the shot will cover the range.

To determine the necessary charge the use of a chronograph is not essential. A single chronograph is not to be depended on, the instrument is a delicate affair and its results would hardly be fully satisfying unless it were manipulated by one habituated to its use. A simple and reliable determination would be to elevate the piece for a given range, fire it, angle the point of fall and increase the charge as might be needed to carry the shot to the desired point.

We cannot yet say whether the object will be located by a depression instrument or by two instruments measuring horizontal angles, but as the single instrument requires at least fifty feet altitude, requires for its objective the water line which is not clearly defined in the case of a moving vessel ; which has to contend with erratic refraction, and which is apt to have the water line hidden when the vessel is firing, the question of its entire success seems problematical. The instruments now in use, though more liable to cause erroneous results than when the work is done by a single brain and eye, are adapted to sites of whatever height, disregard refraction and can be ranged on any part of a ship from the water line to her mast-head. As we are accustomed to use them here, however (all details considered), the system is not satisfactory, though it may answer well enough to plot shots on a map subject to considerable expansions and contractions.

In the JOURNAL for September Captain Chester redeems himself handsomely, as we inferred from a previous article that he had joined the ranks of the laggards. In his ideal system of defense, Capt. C. touches on a matter of such importance, the very life almost of a system of modern fire tactics, that his words are reproduced here.

After leaving the guns we are taken to the conning-tower of the group commander where (words italicised by writer) :

" We find him at his station in a conning-tower similar to that of the captain, but with a view of the field of fire of the whole group of batteries. There is a centre table in it similar to that already described, with the chart of the harbor engraved on it in the same way, but without any of the red lines which we saw on the captain's chart. We notice, however, some new markings on this table. It is graduated in

two series round the edges to read directly to minutes. The centres of graduation which represent the ends of the measured base are furnished with station posts secured firmly in position by nuts screwed on their projecting ends under the table. Pieces of fine steel wire attached to rings which fit over the station posts complete the outfit of the table. *These wires* are attended to by two non-commissioned officers. There are several other non-commissioned officers in the commandant's conning-tower attending to the telephones which connect with the captains of batteries and the *base-end observers*.

When the group of batteries are being exercised together, the firing, as already said, is controlled by the commandant. Suppose we visit the commandant's conning-tower during drill exercise. We find him at his telescope, scanning an approaching steamer. Presently he says "Ready for the position of such and such a steamer," and the warning is telephoned to the base-ends. Almost immediately the message "Ready" arrives from both observers. The commandant then presses a button which rings a signal bell at both base-ends, and in a moment the angles are reported. The *plotting sergeants* stretch the *wires* to the indicated graduations, and the adjutant noting and marking the position of their intersection, reports the number of the square. The commandant, again consulting a stop-watch which he has before him—he consulted it first when he first rang the signal bell—rings another signal, and another observation is taken and the angles reported and plotted, the adjutant again marking the position. The speed and course of the steamer are now known, and the commandant is able to anticipate her arrival in any square."

The foregoing extract gives a true picture of our *modus operandi* of angling and plotting work—a method too cumbersome and complicated for satisfactory vessel tracking work. A simplification somewhat as follows should be made.

At station A, which should lie outside of smoke field, the telescope, *without any graduated arc*, should stand on *metal map*, at the point of station A on map. Below the telescope, half an inch above the map surface, there should travel a wire stretched taut and lying in the same vertical plane as does the axis of telescope over it. Thus, as the telescope follows the vessel, the wire, at all times, indicates her direction from station A.

The telescope at Station B, two miles or so from A, as we must consider ranges far beyond that of the 15-inch gun, would have a graduated arc, larger than on present instruments, which should lie *above* the telescope instead of below as now. The graduations to 15′, should lie on the face (tire, so to speak) of the arc curve, and have a vernier like that on the Zalinski sight—such a vernier being simple and its reading quickly caught. For prompt indication to the eye, each 15′ mark should lie in a streak of red; each 30′ mark in one of white, and each 45′ mark in one of blue.

The observers at A and B should be in telephone connection—instruments being at the mouth and ear of each.

A clock in station A, when started on its work, rings a bell for three seconds every fifteen seconds say. Observers at A and B, by telephone, agree on ship to be observed and the point for observation; the bell starts; observer at A counts through his telephone—1, 2, 3—the 3 as bell stops. Observer at B stops his telescope at 3, raises his eye, takes reading and telephones same, while continuing his telescopic traversing, to the observer at A who calls it out to the *one* "threadman." This would be repeated at each bell ringing.

By the simplification suggested, three men will follow a ship and locate her promptly; a fourth would, by pencilings, fix her course and pass to telegraph operator the message for group of guns. With less probability as to accuracy, and more time, seven men are necessary to do the same work by methods and instruments as now.

Whatever the nature of the range finder used there must, of course, be maps. As batteries will cover themselves with their own smoke, observing stations should be located beyond the smoke field, and where these stat ons are the maps should be.* The present paper maps will not answer requirements as their expansions and shrinkages are some 35 yards in 3000. Shots known as hits, plot as misses, and misses as hits; arcs and ranges varying at different times. *Maps should be of metal*, with wooden frame to allow of tacking on tracing paper for plotting purposes and for preserving the metal surface from scratches.

In order to obtain with facility, rendering calculation unnecessary, the ranges and azimuths of square centres, there should be drilled, in the map, a small hole at the point of each gun pintle (or pintle of central gun of each group, as may be), and at the central point of each mortar battery. There should be provided with the map a graduated metal circle with rotatory radius, its edge graduated to five yards and its end carrying a vernier. With this device pivoted at any desired pintle, square centre azimuths and ranges could be determined very quickly.

Whether the map surface will show the usual squares or not is yet to be determined. In either case, the scale as now prescribed will not answer coming needs, as with that of 100 yards to the inch the map would be so large as to be practically valueless. The scale should be about 200 yards to the inch, which will keep the map within reasonable and handy limits to 10,000 yards range, or more.

If by the "square system" is meant a restriction to square centres as objectives, the idea is defective, as the fire area would be full of dead spaces and none such should lie before guns of the accuracy of the modern rifle. We are assured by the Chief of Ordnance that our 8-inch rifle at 3000 yards places its string of ten shots in a circle of a little over seven feet diameter. Such work as this from the 8-inch rifle, combined with the knowledge of work by heavier foreign guns, would warrant us to expect that with our larger guns at six miles range, fifty per cent. of the shots would fall in a rectangle 60 by 15 yards, the longer sides lying parallel with the plane of fire. If this accuracy is not beyond reasonable expectation, there would seem to be but little doubt concerning the question of lane *vs.* concentrated fire from a group, considering the intervals necessary between large rifles. If the objective point can be accurately fixed, group fire should be concentrated, and especially at the more moderate ranges.

Although ranges and azimuths for a single gun, or for a group by lane firing, may be quickly found with a map devoid of squares, experience must show whether or not the latter are to disappear. In their favor there is a strong feature which should not be overlooked and it is this: The commanding officer wishes to locate a vessel for the fire of one or several groups. He fixes her in square so and so. Probably by no method other than that of squares can information and orders be generally or specifically conveyed so simply as by the message: "Fire (or such groups concentrate) on vessel in square so and so."

A good range table under the square idea is a matter involving considerable painstaking labor, as every figure in it must needs be as reliable as a figure in a table of logarithms. Were angles and distances to square centres dependent on calculation, a range table for one gun would give work to two men (all details needing such careful verification) for fully a month—more nearly for two. With a metal map, however, and movable arc as described, an azimuth and its corresponding range would be found and tabulated very quickly. With this data only there would be "dead spaces" and to eliminate such the range table should contain other data. Whatever preliminary work may have been given to a range table should no more be considered than similar work

* Conceding that "smokeless powder" will (all things considered) triumph over the old reliable mixture, still the observing stations should be more or less remote and unseen by the enemy.

in the gun construction. The point with either should be, at the moment of use, is it simple in its working—is it reliable—is it the best?

On page 1021, JOURNAL for September, 1891, was shown an idea of Azimuth Range Table, but as the details of its use were not explained, a similar page is here shown:

TOP NO. 46 8-INCH CONV. RIFLE NO. 15

Side Nos.	Azimuths (corrected for drift) and Elevations. (Quadrant) °	′	Ranges and Values of 1 minute for Wind, yards.	Flights (Seconds) and Changes in Elevation 10 yds (minutes.)	Side Nos.	Azimuths (corrected for drift) and Elevations, (Quadrant.) °	′	Ranges and Values of 1 minute for Wind, yards.	Flights (Seconds). and Changes in Elevation for 10 yds. (minutes.)	
1	25 12	29 00	5236 1.5	16 2	21	39 6	52 52	3545 1.0	9 1.6	
2	25 11	59 43	5145 1.5	15 2	22	40 6	56 40	3470 1.0	9 1.6	
3	26 11	29 25	5055 1.5	15 2	23	42 6	03 27	3395 1.0	9 1.6	
4	27 11	01 07	4966 1.5	15 2	24	43 6	13 14	3322 1.0	9 1.6	
5	27 10	33 50	4878 1.4	14 2	25	44 6	26 03	3250 1.0	9 1.6	
6	28 10	08 33	4790 1.4	14 2	26	45 5	43 52	3179 0.9	8 1.6	
7	28 10	43 16	4704 1.4	14 2	27	47 5	02 40	3111 0.9	8 1.6	
8	29 10	20 00	4617 1.3	13 1.8	28	48 5	26 30	3044 0.9	8 1.5	
9	29 9	58 43	4530 1.3	13 1.8	29	49 5	52 21	2979 0.9	8 1.5	
10	30 9	38 28	4444 1.3	13 1.8		x	x	x	x x	
11	31 9	18 13	4359 1.3	13 1.8						
x	x	x	x x	x x						45-46

Assuming concentrated group fire, the chief of each gun of the group would have a range table pamphlet for his gun, and at the principal observing station of that group there would be a duplicate of the table pertaining, say, to the central gun.

The ship to be fired at by that group is located, and if at the centre, say, of 46-29, the message to the group would simply be: 46-29 F F F.* Each gun chief, by means of the catch numbers showing marginally, would turn at once to the page headed 46, find side number 29, cause his gun to be given table elevation and azimuth. While these were being done he would consider the probable deviating effect of the wind for the range

*F F F—the signal to fire.

shown 46-29. Assuming the wind to be such as would throw the shot ten yards to the right, $\frac{10}{5.5} = 11$ minutes would be the decrease of table azimuth to be made and the gun would be pointed 49° 41′ direction.

The wind factors, but not for wind, would also be used, when occasion required, at the principal of a group observing stations. A stationary vessel is located, say, at which is a "dead space." The ship's centre l es 50 yards to the left of square centre, and 30 yards further than distance from gun to square centre. The observing station figuring would be: $\frac{50}{1.8} = 39'$, $3.0 \times 1.8 = 5' +$, and the message sent to group would be: "46-10 subtract 39 El. 9-33". Square 46-10 would be at once found, elevation of 9° 33′ gives each piece and the table azimuth of each diminished 39 minutes, which would bring the concentrated fire on the desired point—wind allowance to be made as before explained.

The best means of transmitting orders and intelligence *to guns* has not yet been determined; it is not known if there has been any special experiment as to comparative merit of instruments in this very important particular. Word will be sent electrically, but the telephone will not answer, as its satisfactory use depends on surrounding stillness. The ordinary telegraphic instrument will not do, as the failure at any moment during the transmission of a message to catch a tick or two causes loss of time in getting the thread again. The drawbacks in the particulars named, both as to the telephone and ordinary key and sounder, would doubtless be obviated by the use of a *self-recording instrument*. With such a device the group is not dependent on the ear or memory of the receiver as the message appears speaking for itself.

We have no elevation indicating device best suited for azimuth practice. A gun is directed and elevated (to do the latter now requires exposure of the gunner)—its elevation is to be changed, and it must be done quickly. To do this with existing means the gunner must *first set his sight* to the desired elevation and *afterwards* commence elevating (or depressing) the gun. The elevation indicator should be attached to the trunnion; be read from below the crest; the piece should begin rotating immediately on receipt of orders for change of elevation, and its rotation should be stopped when the elevation arc shows that the desired elevation has been reached. Such an arrangement would save several seconds as compared with results obtainable from any of our devices known—valuable time when a moving vessel is the object.

This year it was ordered that firing with the 15-inch gun should be "at squares." At a certain post how was this done—by locating points with angle measurers and furnishing the information to the guns; so locating a number of points and traversing the pieces in various directions? Oh no, because of the stalking "figure of merit" spook, batteries at the post must not be placed at a disadvantage with batteries at other posts which might be firing by direct sight in the direction of some fixed object—traverse circles not graduated perhaps. So, on the map two square centres, lying at 1700 and 2700 yards, were located by *finger* and at those two points all the firing was done. Thus, in firing at square centres only, at the same two points only, and in neglecting to use the angle instruments to locate objectives, the conception of "azimuth" firing, "square" firing, or by whatever name it may be called, was shorn of about all of its practical worth.

For some years now we have been using the barometer, wet and dry thermometers, anemometer and wind vane, in connection with our practice occurring once a year. By means of these instruments we have reported, for each shot, the atmospheric pressure, temperature, humidity, weight of a cubic foot of air, etc., and yet, as the ordnance sergeant was lately overheard to remark: "They are using a great deal of science, but don't shoot any better nor they did twenty years ago," a rather unkind remark to say the least of it. The anemometer and wind vane are desirable because the wind

effect is important, and it is essential that gunners should learn from experience how to allow for it. The other instruments should be relegated to the proving ground where they are constantly handled and whence any practical results that might in course of time be obtained would be communicated to the users of guns.

If adverse winds never blew, the refinements resulting from barometric and thermometric readings might *possibly* be of practical use, but as the conditions of still atmosphere favorable or unfavorable to shot flight are almost always affected by ever varying winds, thermometers and barometers are of no value to us. The same moist air that softens the residuum in the bore, and offers less obstacle to shot flight is at the same time absorbed by the powder, thereby affecting its strength—who can tell when one of these things neutralizes the other? The hotter the day the more the expansion of the shot both in length and diameter—what is the effect of this as compared with those obtained at some time when the shot had less volume and some half a dozen conditions of other natures existed? All these mites are so tenuous as to be of no value whatever to gunners. The wind vane and anemometer are the only tools that the practical artillerist can, from present lights, ever hope to profit by.

In the several points touched on, the writer disclaims any originality of ideas. They have been suggestions (from one and another officer of his regiment) which, in conversation and discussion, have stood out prominently as important, and which have left strong impressions as to their soundness.

It is but a few years since the first impulse was given to harbor charting and systematic sea-coast practice. With us, defenses and weapons are on the verge of great changes, so also, should be our methods in some important particulars. Serious problems are looming up; if we cannot successfully grapple with them, if we cannot create or otherwise secure the necessary skill for at least a certain percentage of our personnel; then the country is spending much money on modern improvements from which it will not get full return in the hour of need. It is not necessary to particularize as to the skill and intelligence needed, but that it is painfully lacking is illustrated by the following incident:

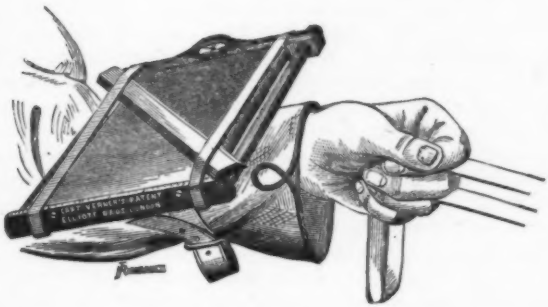
An officer recently had his men on the parapet to judge as to the speed of passing vessels. He stated a little data and added: "Now, by simple proportion. * * *." Turning to the nearest man he asked: "Can you do simple proportion?" "No, sir." The next answered the same and so throughout.

Skilled artillery soldiers (the non-commissioned officers and "first class gunners"), having here in view all that is implied by coming requirements, must be clever men and such men, as a class, can be obtained, and be obtained only, in just the same way as they are secured in civil life, qualifications there commanding their price.

The Sergeant of Ordnance pushing powder and projectile into the new, big experimental cannon, fired by electricity, draws at least from $34 to $37 per month, and is assisted, probably, by privates drawing the same pay as a sergeant of artillery. The corner stone of any really satisfactory artillery progress will lie in righting this incongruity, as the future acquirements of competent artillery non-commissioned officers and "first-class gunners" should be those, at least, of non-commissioned officers and privates of ordnance who, however, are not overpaid.

Artillery affairs will ever languish so long as the arm continues without a chief.

Reprints and Translations.*



RAPID FIELD-SKETCHING AND RECONNAISSANCE.†

By CAPTAIN WILLOUGHBY VERNER, Rifle Brigade.

THE subject of rapid field-sketching on foot or on horseback, is one which opens up a very wide field to any officer with a good eye for a country, and who is also able to make use of his fingers. I am far from saying that a man must be a good freehand draughtsman in order to be able to execute a military sketch, but I am strongly of opinion that the man who can draw is, to use a nautical expression, many points to windward of the man who cannot. The latter may, by dint of the most laborious exertions, succeed in time in turning out a decent sketch, but the more the work in which he is engaged departs from the rigid rules of a scientific survey, and approaches to that of the landscape sketcher, the further behind lags the man who has neither a turn nor an eye for drawing.

To the uninitiated it would appear to be almost unnecessary to pass any remarks on the subject, but it is a fact, albeit a somewhat absurd one, that many a man who is perfectly candid in admitting his want of knowledge in other technical military matters, will not allow for a moment that his sketching is not all that can reasonably be desired, and not uncommonly looks upon any criticisms on his performances in that line as almost a personal affront. If it be granted that the essence of military sketching is rapidity, and that the quicker a man's eye takes in a bit of ground, and the more accurately his mind retains an impression of the same, the better will

* Please address communications concerning reprints, translations and reviews to Lieut. J. C. Bush, editor of this department.

† From *The Illustrated Naval and Military Magazine, London.*

be his work, can it be doubted which man, the draughtsman or the non-draughtsman, will be the most likely to produce a *useful* sketch in a given time?

It must be remembered that a sketch is generally made for the information of some person who has not yet seen the ground in question, hence the only real test of its value is its capability of conveying a true impression of the portion of the ground it represents to others. I would wish, therefore, to start on the subject of rapid field-sketching, either mounted or on foot, with the following assumption, namely, that in order really to attain great facility in this line, and to produce useful sketches against time, it is an enormous advantage to have a natural taste for freehand drawing, and that the man with this talent will, ninety-nine times out of a hundred, distance the man whose only knowledge of using his pencil is derived from studying military surveying.

Now this taste for freehand drawing need not be a very developed one, but the more developed it is, the better and easier will a man when engaged in military sketching draw the detail which he wishes to place on record.

I do not want to discourage anybody from attempting to master the art of rapid field-sketching, in spite of their natural inability to draw. I only want to put it plainly before them that they are embarking on an undertaking in which they are very heavily handicapped, and I would say to all of them that they must not be disheartened or surprised if they see men who possess the turn for drawing distance them in the race.

That it is possible for men to become excellent map drawers, giving them plenty of time and instruments, is altogether beside the question. I deal only with *rapid field-sketching*.

Before proceeding further I wish it to be distinctly understood that I am not going to make any startling revelations or divulge any new processes with regard to field-sketching. The subject has been exhaustively treated in all its technical details by people far more competent to do so. All I seek is to endeavor to describe the various methods by which sketches and reports can, in my opinion, be most rapidly and efficiently executed in the field, and at the same time to give all the information I can on certain minor points which experience has taught me are well worthy of attention.

For rapid work in the field, nothing can equal the "cavalry sketching-case" as it is commonly called, and it is with this little instrument that I propose to deal in the following pages. It is the invention of Colonel W. H. Richards, for many years Professor of Military Topography at the Staff College, and to whom I am indebted for my first lessons in its use. For some years it has been the custom to instruct officers in surveying with the prismatic compass, and the natural result is that it is the exception to come across any who are acquainted with the use of these sketching-cases. Of course, there are men to be met with now and again who have learned to use them at special classes of instruction, as at the Staff College; but these are the exception, and I have over and again seen men who were excellent draughtsmen with the ordinary tools of the craft, but who were totally unacquainted with the simpler, more rapid, equally effective, and more soldierly method of working with the cavalry sketching-case. Indeed,

I shall never forget my feelings on one memorable occasion when, after having equipped a friend with my own favorite sketching-case, and, as I imagined, given him full instructions as to how to proceed, he returned it to me with thanks, and an intimation that he had found it so complicated that he had "fallen back on the simpler method" of carrying a large board, prismatic compass, protractor, etc.

It is owing to similar experiences that I have been induced to write the following, as I am convinced that when once any man has mastered the extremely simple process of sketching with this board, he will never use anything else for rapid work in the field.

"Well-informed people" are, therefore, warned off, and are respectfully requested not to waste their time in perusing the following very elementary treatise.

In order to use a cavalry sketching-case with effect, it is, of course, absolutely necessary to have a thorough knowledge of the ordinary details of "Military Topography" which come successively into play during the process. These are especially:

(*a*) The construction of scales both for distance and time for foot and mounted work.

(*b*) The principle of contouring.

(*c*) Sketching with the plane table.

Anybody can become proficient in these with a reasonable amount of study; those which can only be properly acquired by constant practice in the field are:

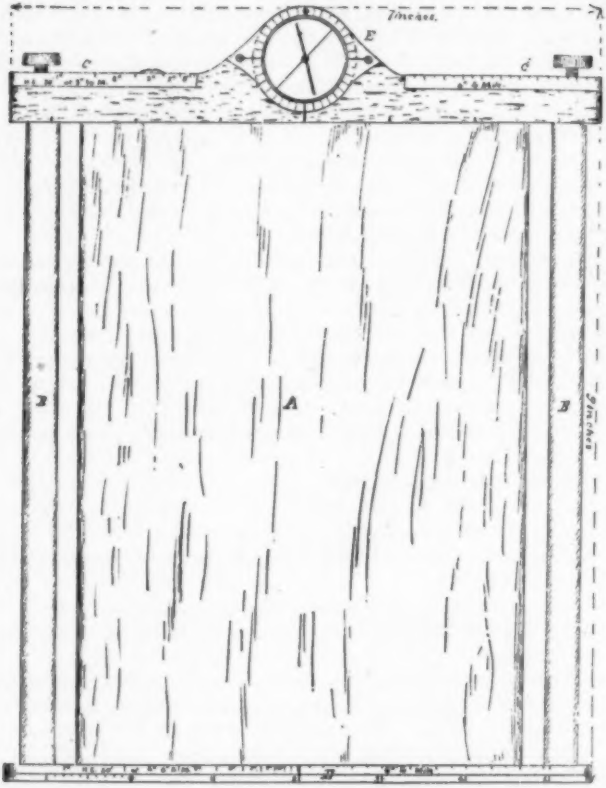
(1) The power of approximately estimating distances, and of judging gradients of roads, slopes of hills, and elevations of high ground at a distance.

(2) The facility of drawing in on the sketch any particular detail (such as a farmstead, a railway, or stream) at some distance from the road at the proper interval (as estimated by the eye in No. 1) without having recourse to the scale of yards on the ruler.

(3) The habit of drawing in rapidly the *general* direction of a road or of any particular object without observing its direction precisely as with a plane table.

But all these are of little avail if a man has not the power of taking instantaneous mental notes of everything which comes within his view or knowledge, and which is likely to be of importance in military operations. It should be the great aim and object of every man who aspires to be good at reconnaissance so to discipline his powers of observation for each day's work that he instinctively notices everything of military importance, giving prominence to those details which are of especial value with regard to the particular nature of the work on hand.

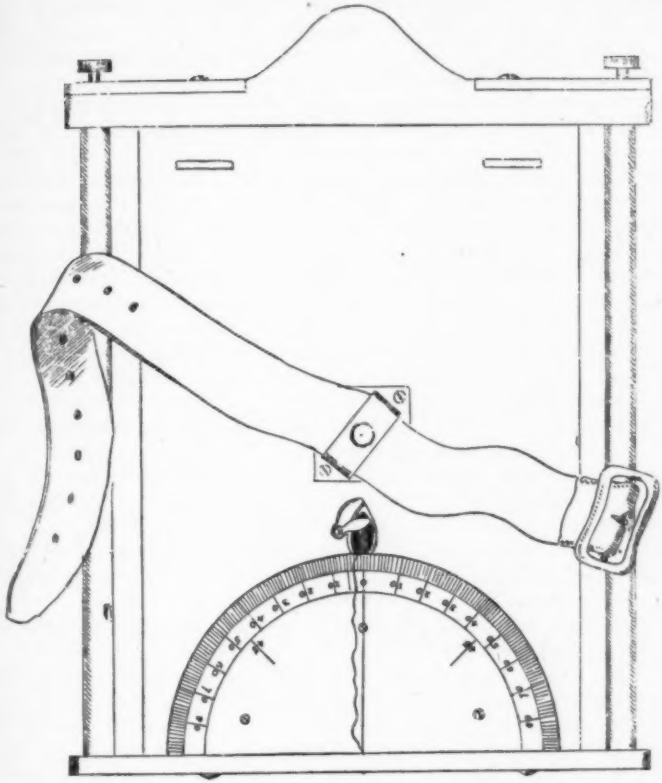
For the benefit of those who are unacquainted with the cavalry sketching-case, I will now describe it in detail. Col. Richards' original case, which embodies the principle of all those since constructed, is a small drawing-board "A" about six inches square, fitted with wooden rollers B B′ on either end, which revolve in sockets in a head-piece C C′ and a foot-piece D fixed on opposite sides. On these rollers a strip of paper of any required



length, say two feet or more, is wound and thus stretched across the board A. In the head-piece C C' a small magnetic compass E is countersunk in a collar in which it can be revolved. On the glass of the compass a fine line is engraved, which is termed the "working meridian."

In the centre of the back of the board there is a metal pivot to which a strap is attached, which latter is used to secure the board on the left wrist when working with it. To use the board, the "working meridian" is set in the required position by turning the compass-box round in its socket. The relative position of the "working meridian" to the board itself, having thus been determined, the board is "set" for sketching by revolving it on the pivot beneath it until the "working meridian" coincides with the direction of the magnetic needle when at rest.

To take an example, supposing that it be required to sketch along a road running east. It is obvious that to get full advantage out of the board, it would be necessary to "set" it so that the length of paper on it corresponded with the general direction of the road, that is, so that the inner edge of the



head-piece pointed to the east. This being the case the needle would necessarily be at right angles to the road, and it is plain that if the "working meridian" be adjusted in this position and the board turned until the needle coincides with it, it will be truly "set" for sketching along the road in question.

It will be gathered from the above that the cavalry sketching-case is nothing more than a miniature and portable form of the plane table, and hence that to use it with effect it is advisable to practice sketching with that instrument, or with the more rough and ready makeshift of a common drawing-board and a magnetic compass.

With the sketching case, the rule provided with sight-vanes, as used with the plane-table, is replaced by a simple straight-edged piece of wood, with which the direction of any distant object is noted by aligning the ruler on it and marking its position on the sketch with a pencil line. It is undeniable that this process is a rough one, and likely to strike the scientific surveyor aghast; but it should be borne in mind that rapid field-sketching and sur-

veying are two very different things, and, further, that it has been proved over and over again that this apparently rough and uncertain process is *quite sufficiently accurate for ordinary military purposes.* Indeed, when used dismounted, the board being carried in the hand in lieu of being strapped to the left wrist, almost any ordinary degree of accuracy (such as with a prismatic compass) can be obtained by combining the process of an "eye sketch" with that of the "plane table."

Having thus explained the general principle of these boards, it will be necessary for me to describe particularly the pattern I at present use, since many of the details of sketching which I am about to discuss cannot be carried out in the field on a board unprovided with some of them at least.

The first question which naturally presents itself when deciding upon a board of this sort is the size. Portability is the essence of all the articles of a soldier's kit, and it is necessary to have a board which can be carried or stowed somewhere without causing inconvenience. Thus a board which can be carried in an ordinary sabre-tasche or an officer's haversack or a roomy pocket, is about the most convenient size, and after various experiments I have found this to be about 9 inches wide (across board and compass), and 7 inches long (across from roller to roller). This will permit of a width of paper of 7½ inches, which at a scale of 2 inches or 3 inches to a mile will take in a considerable extent of country. It is obvious that practically an unlimited *length* of paper can be carried by reason of the rollers.

A very convenient way of carrying the board when not in use is in a leather case, which can be strapped to the saddle after the manner of a shoe case, or carried on a waist-belt when working on foot.

One of the most vexatious things in working with a cavalry sketching-case, is the liability of the rollers in time to work loose, when they fail to stretch the paper across the board, and it consequently bulges out and offers an impossible surface to draw upon. The discomfort caused by this can only be realized by those who have experienced it when sketching under arduous circumstances. I have endeavored to obviate this by providing each roller with a clamping screw at one end, by which means they can be regulated to any required degree of stiffness. In order to clamp the roller, a turn of the screw C brings the point of the pivot B against the interior of the roller at A. The small stud is to prevent the screw working out and being lost.

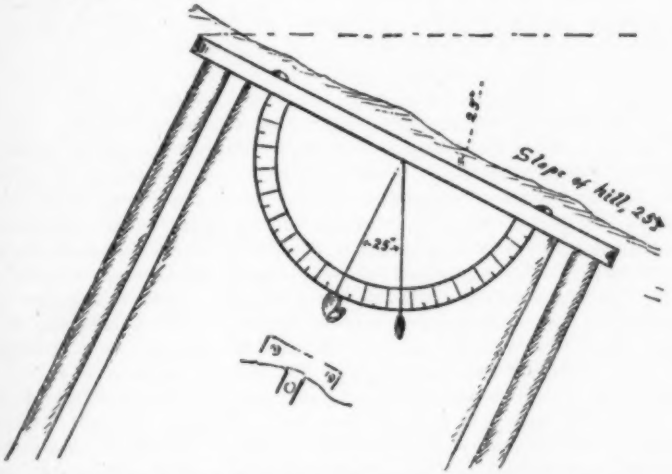
Since the correct adjustment of the working meridian is a very important factor in the process of sketching with one of these boards, I recommend that the magnetic compass should be sunk in a metal collar graduated into divisions of ten degrees. This enables the position of the meridian to be noted, and affords other advantages into which I will enter more fully hereafter.

It is a great advantage to have the scales most commonly used in surveying engraved on the metal footpiece, etc., of the board, and for the reason that so long as the board itself is at hand, no other instruments are required. In a campaign in a civilized country the loss of a protractor might be a matter of little moment, but to the British officer who so frequently is called upon to serve in some savage and remote part of the world, it entails ex-

treme inconvenience. The scales that are probably the most useful, and which I have adopted, are the following :

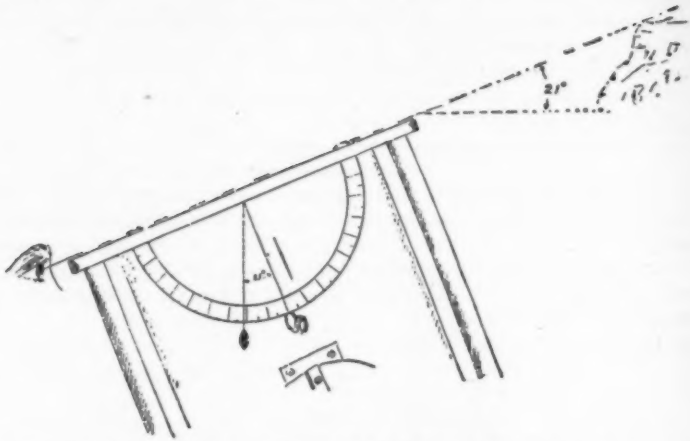
1. A scale of inches and tenths of an inch.
2. " " 4 inches to a mile, to show 50 yards.
3. " " 6 " " " "
4. " " horizontal equivalents—normal.
5. " " H.E. for 30 feet vertical intervals at 3 inches to a mile.

With these, it is possible to do any ordinary work. No. 1 enables any particular scale required (such as for a horse's paces) to be constructed with sufficient accuracy. Nos. 2 and 3, being divided into fifty yard intervals, can be used for scales of 2 inches and 3 inches to a mile, and, of course, for any multiples of 4 and 6. The last (No. 5) is a very useful working scale for sketching on horseback.



I have found it to be a decided advantage under certain circumstances to be provided with a clinometer, and a very fair makeshift one can be made by screwing a semi-circular boxwood protractor on the back of the board. A plumb-bob is suspended from the centre of the foot-piece, and when not in use is fitted into a cavity in the back of the board, where it is retained by a small catch. This clinometer is used after the fashion of the old Sandhurst pattern instrument of that name, the screws attaching the footpiece to the board making good fore and back sights wherewith to take the elevation or depression of objects.

Again, by holding the board sideways, it is easy to ascertain the slope of the profile of a hill. This is often a great help to a sketcher, and cannot be done with the "Watkin" clinometer, although the "Abney" level admits of it. If ordinary care be used, it will be found that the wind will affect the result of any observations taken with this clinometer to a very small extent on account of the board sheltering the plumb-line.

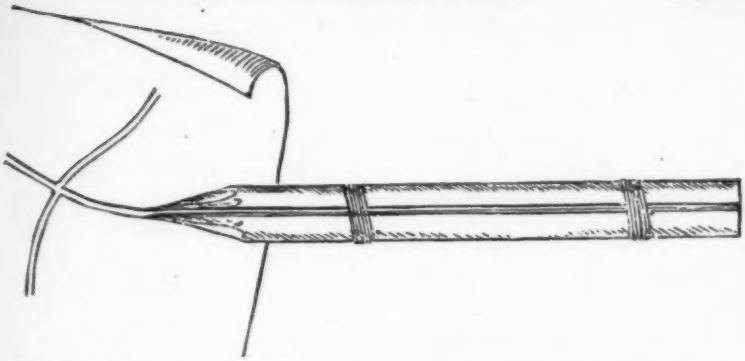


I am perfectly aware that most skilful draughtsmen say that they prefer to estimate slopes by eye rather than by a makeshift clinometer, but the ordinary sketcher requires some such assistance from time to time if only to give him confidence, and occasions may arise when it is of great importance to make the most accurate observations practicable under the circumstances.

A very useful plan is to graduate the headpiece and footpiece of the board into divisions of one inch at points exactly opposite to one another. This enables a sketch to be divided into sections of one inch or more by ruling lines from one graduation to that opposite to it. This is especially useful when sketching by "time," or when working with the aid of maps, which it is desired to enlarge and fill in with military details.

So much for the board, now for the tools required to work with. I am one of those who look upon no detail as too trivial to be alluded to, when a question like sketching in the field is under discussion, for it is precisely by bestowing the most careful attention to such minor points as a hard or soft chalk pencil or a blunt or pointed black-lead one that a sketch may prove to be of the greatest value owing to its clearness or to be so confused as to be practically useless.

In rapid sketching, especially when mounted, it is a great advantage to carry the pencils actually required for constant use in some sort of hold-all. These can be made or obtained in every size and shape, but after having innumerable patterns made, I have come to the conclusion that the best sort is the simplest possible. This I take to be one that will carry a couple of black pencils, a small bit of red and blue chalk, a penknife, and a piece of hard India rubber. I say two black pencils, for if one be dropped or broken, there is a reserve one handy. The red and blue chalks are used now and again to mark any important detail, such as a masonry wall or a stream which, in an extended sketch, may become partially obliterated and perhaps omitted during the process of cleaning up. The India rubber is, *of course* attached by a piece of string to the hold-all. Now, although I advocate



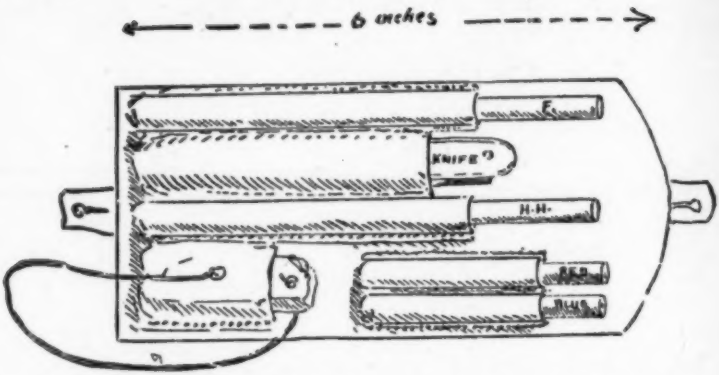
India rubber to be carried, I do not recommend its use except now and again, when necessary to clear up some confused part of the sketch; should any line be drawn in error, the best way is to erase it with a few short diagonal strokes on the spot, and to rub it out when finishing up the work. I trust it is needless to caution anybody as to the fatal effects of using India rubber in wet weather. The hold-all can be either buttoned on the breast of the jacket, or on the stud of the off wallet. Undoubtedly the most effective method of finishing up a sketch is with India-ink and water-colors. This process is, however, frequently inadmissible in the field, and recourse must be had to ordinary pen and ink or pencil and colored chalks. I would always advocate pen and ink being used when possible, because when a sketch is in the somewhat confused condition inseparable from rapid work in the field, it is easy to pick out the detail and write in the notes clearly over the rough jottings made with pencil. The whole sketch can then be cleaned with a hard bit of India rubber or piece of stale bread, and the colored chalks applied where required. By this process there is but little danger of accidentally obliterating or omitting some important detail or note made in pencil in the field. When no ink can be obtained, a hard indelible pencil is the next best substitute. "Solid ink" pencils are generally a failure, as they are apt to smudge if wetted by mischance.

Since most reconnaissance sketches in a civilized country have many roads in them, it is an immense saving of time and a great addition to the neatness of a sketch to use a "road-pen." In my pencil sketches I invariably use what I may term a "road-pencil," an arrangement which I make as follows: Take a hard pencil, the harder the better, and cut it into two equal portions, next slit each of these down their middle and join the two pieces containing the lead lashing them with a string.

If now the lead points be sharpened at one end and neatly scraped away on the inside edges, a most effective instrument will be provided wherewith to draw double lines.

Besides this road-pencil, I would recommend the following articles to be carried for finishing up a sketch on the completion of the work in the field, viz.:

A pen in a case with some spare nibs, not "crow-quills," but any fine



steel pen; a small bottle of ink of the "musketry register" pattern for choice, well corked up; a small box of chalks of the conventional colors, these must be really hard, and not like the soft chalks supplied to H.M. Stationery Office, which are worse than useless for this sort of work; a good penknife with two blades is an invaluable companion, and is best carried in the hold-all, where it is ready for use and not likely to be forgotten and left behind. As I have already said, the pen and ink may be replaced by a hard indelible pencil.

Now as to the paper; this should be smooth in texture and "hot-pressed," and should be cut in suitable lengths of 30 in. or so and 7½ in. in width, tightly rolled and tied up. Thus folded it will travel securely in the wallets or saddlebags. If it is desired to take particular care of any sketches, an old busby-plume case forms an excellent receptacle.

The sketching-board, when not in actual use, can be conveniently carried strapped to the bridle arm above the elbow, where it will ride in safety out of the way.

The straight-edged ruler needs but little description. Any piece of wood will do, the best form being about 10 in. long by ¼ in. broad, and with bevelled edges, upon which the scale employed can be marked off in pencil from the scales engraved on the board. Messrs. Elliott have made me an excellent pattern weighted with a strip of lead along the centre; this prevents the wind from blowing it about when in the act of taking a direction with it.

In order to facilitate this process of noting a direction when mounted (and when one hand in consequence is occupied by the reins), it is customary to have a couple of India rubber bands round the board, under which the ruler is slipped. For this purpose I recommend common white elastic about ¼ in. wide, as being far preferable to the red vulcanite bands commonly used, and which catch the ruler, and are otherwise objectionable. The ruler can best be carried, when mounted, in the boot, after the manner of a Highlander's *Skene Dhu*, or it may be carried in the hand, but *never* in a shallow pocket or stuck under the bands on the board. Beginners affect both these latter customs only to find on requiring their ruler suddenly that it has been dropped perhaps a mile in rear.

ELECTRICITY AND ITS TACTICAL VALUE FOR MILITARY OPERATIONS.

By MAJOR R. L. HIPPISLEY, Royal Engineers.

(*Lecture of Aldershot Military Society.*)

I.—HISTORICAL.

THE employment of the electric light in warfare is by no means a new idea. In a pamphlet written in 1851 by Captain Martin de Brettes, and entitled "Illuminating Devices used in war, and the Electric Light," there will be found enumerated the various uses and advantages of the electric light for siege warfare and for night signalling.

The first practical attempt to make use of it was made by the French in 1855 at the attack on Kinburn by the Allies, just before the conclusion of the Crimean War. It was used to light up the point of attack. This experience led the French authorities to make efforts to construct an apparatus suitable to the wants of an army in the field; and in 1859 they were further stimulated in this direction by the want of it, felt by their army in Italy. These experiments were interrupted by the peace of Villafranca. Subsequently during the war against the King of Naples in 1861, the French general had an apparatus constructed for the attack on Gaeta, but it appears that there was no occasion for its use.

The dynamo machine had not then been brought out, and the methods adopted for producing the electricity were costly and cumbrous, consisting as they did of primary batteries, both brittle and importable.

It was not until the siege of Paris, 1870–71, that electric search lights were employed with much effect. Both sides had them. The besieged garrison used them to discover their opponents batteries and trenches at night, and the investing army used them, in addition, for directing the fire of their guns. The French still employed primary batteries to produce the electricity, only one light, viz., that at Montmartre, being installed with a dynamo machine, whilst the German lights were all supplied from dynamos, and were, in consequence, much superior. After the conclusion of peace both the French and Germans devoted considerable attention to perfecting their electric light apparatus for war purposes. In the year which followed the Franco-German War immense improvements were effected in the machines for producing the electric light, and assisted by this circumstance and by the general attention which had been directed to the subject, all civilized nations have come to regard the electric light as a necessity in time of war.

Military operations have never been considered to cease at night, but during the last few years increasing attention has been given to that portion of warfare which may be said to begin at night. A great deal of this attention may, I suppose, be attributed to the success which attended the attack on Tel-el-Kebir, which was at the time of its accomplishment receiving the praise of all Europe.

The need for artificial lights in night warfare for discovering where the

enemy was, and what he was about, manifested itself originally in the inventions of the Bengal light, and of the old light balls. These, when armies fought at close quarters, did their work very well. But now when nearly all of the fighting is done at distances which render such devices useless, we have to employ more powerful illuminants. The special utility of the electric light for this purpose lies not only in its extreme brilliancy, which as every one is aware far exceeds that of all other artificial sources, but also, and chiefly, in the fact that the space occupied by the source of light itself is so much smaller than that of any other light of the same illuminating power. This property enables one to place it accurately in the focus of a lens or mirror, and to produce from such a combination a sharply defined, nearly parallel beam of light. The larger the source of light the more dispersed and confused is the beam, and though such a source may emit more light than a smaller one, its power to illuminate things at a distance may be much less. I do not intend to trouble you with any technical details of the method of producing the light, or with any descriptions of dynamos or other necessary apparatus beyond a few remarks here and there as to the means adopted for making it portable. What I ask your attention to is the question of its use for military operations, and how it can best be manœuvred so as to bring about the most desirable results.

II.—PRINCIPAL USES OF ELECTRIC LIGHTS IN WAR.

The principal uses to which the electric light can be put for war purposes can be classified under the following heads:

1. *First Class Lights for Fortresses, Coast Defenses, War Vessels, and Submarine Mining Operations.*
2. *Semi-Portable Lights for Embarkation, etc.*
3. *Portable Lights for Field Operations.*
4. *Portable Lights for Land Mining Operations..*
5. *Signalling by Electric Light.*

To deal with all these sub-divisions of the subject in the course of a short lecture would be too comprehensive an undertaking, and it would be unprofitable, because it would be impossible to do justice to any one of them. I propose to confine myself to the consideration of only one of them, namely, the 3d—Portable Lights for Field Operations—and I do so for two reasons, first, because I consider it a more interesting and suitable subject to talk of at Aldershot; and secondly, because being a subject which concerns the army at large, it can only be adequately worked out by the coöperation of all those for whose benefit it is intended to be used.

The question of first-class lights for fortresses is already receiving the attention it deserves at the hands of the Royal Artillery, for the direction of whose guns it is principally required. Its introduction into the vessels of Her Majesty's Fleet is also an accomplished fact, and the necessity is thoroughly felt by the officers of the Navy, who are quite capable of taking care of their own interests. For submarine mine fields it has long been used by the Royal Engineers, and it was in connection with such defenses that it was first developed from a plaything into a machine of real utility. The apparatus required for night embarkations of troops and stores on board ships

or into trains, though a most important adjunct to operations on a large scale, does not require any very exhaustive treatment, nor to be considered in any very great detail, because the ordinary commercial arc-lamps and portable engines will answer the purpose very well, and will generally be forthcoming in sufficient quantities, on mobilization, without our being under the necessity of keeping special equipment in store. Permanent installations have been effected at the gun wharf at Chatham and at the powder magazines at Upnor to enable night embarkations of ammunition and stores to be carried out when emergencies arise.

As the execution of land mines forms one of the duties of the Royal Engineers, we may rest content that a suitable portable electric lamp will be introduced into the service for that purpose by the Royal Engineer Committee when a thoroughly suitable form of battery has been found.

The idea of night signalling by electric light, whether by arc lights or by incandescent lamps, is a subject more interesting to the army at large; but that is also receiving due attention from the Inspector of Army Signalling, and at the School of Military Engineering. The substitution of a small electric lamp and battery for the more cumbersome lime light apparatus is a thing greatly to be desired, because it is more powerful weight for weight; but there is the same difficulty with this application of the light as there is with the miner's lamp, namely the *battery*. There are plenty of good batteries in general use, but they are none of them quite suitable for the rough usage they would be subjected to when employed for signalling.

It is, as I have said, the subject of Portable Lights for Field Operations to which *general* attention ought to be directed. A highly specialized equipment is necessary for this purpose—one which cannot be satisfactorily extemporized on the eve of war, and several units of which ought to be kept in store ready for an emergency. But it will be labor wasted and money ill-spent if this equipment is designed and brought out, and if no one will use it.

III.—USES OF PORTABLE ELECTRIC LIGHTS.

Now an electric light apparatus, portable enough to follow an army in the field, could be made use of for a variety of purposes. Taking first its most obvious use, viz., in sieges; we may take for granted that every first-class fortress will soon have its first-class search lights to which I have already alluded. Messrs. Schuckert of Nürnberg have already manufactured for the Germans, and others, a large number of powerful apparatus, and although we have no details of where they are fixed, it is reasonable to suppose that some of them will be found permanently installed in their principal fortresses. The firm of Sautter, Lemmonier, & Co., of Paris, have done the same for the French Government, and also for the Belgians, the Dutch, the Swiss, and other small states. In England preparations are being made on a large scale for the introduction of the most brilliant search lights for our southern defenses, both sea and land, to be at the disposal of the artillery for defensive purposes. We may, therefore, take for granted that a besieging army will find any permanent fortress, against which it may be engaged, in possession of electric lights with which to search out the night operations conducted against it.

The siege of a fortified place would therefore no longer be the comparatively simple operation of constructing works at night and firing from them during the day. The construction of the ordinary siege works in the method hitherto adopted would not be possible except at an enormous sacrifice of life.

But this disadvantage on the part of the attack can be greatly obviated by the employment by them of electric search lights; for it has been shown from the Milford Haven experiments in 1886, that when the atmosphere is at all heavily laden with smoke or with mist, the penetrating power of the lights from a fortress can be diminished to a large extent by the employment on the part of the attack of another beam, crossing the former at an angle.

At Milford Haven it was found that the penetrative effect of the electric lights of the defense was very feeble when the beams were crossed by those of the attack, as the illuminated spaces at their intersection presented a screen, more or less opaque, according to the amount of smoke or mist with which the atmosphere was charged. The electric lights of the attack were worked with method and with considerable success. One light formed a partial screen by being thrown along one margin of the defended area, under cover of which a torpedo boat advanced unobserved, and was credited with having achieved considerable damage to the defenses. Other lights were directed on the artillery of the defense, the effect of which was to dazzle the gunners and to prevent their laying their guns with accuracy. The lights were occasionally flashed up and down, thereby further confusing the view of the gunners.

An electric beam can therefore be used as a screen, behind which operations can be conducted in secret. The applicability of this use of the light in the attack of a fortress is obvious.

In order to produce this screening effect it is only necessary that a powerful search light should be placed in front of the flank of the ground to be hidden, so that its beam may be projected in front of it. It is better to throw the beam diagonally across the front, rather than to make it traverse straight across, because its obscuring power is much greater when so disposed, and also because it contributes to disconcert the enemy's fire by its dazzling effect upon those having to aim the guns. The projector used should be capable of throwing a very condensed beam, and care should be taken to avoid any stray rays illuminating the ground which is intended to be hidden.

Not only will the electric light produce cover behind which parallels or siege batteries can be commenced, if the nature of the ground and the shape of the fortress admit of it, but it can also be used with great effect for the direction of the guns subsequently placed in such works. The firing can then be carried on at night with almost as great accuracy as during the day. Guns were laid by night at Lydd in 1886, on a work illuminated by a beam from a flanking position 1200 yards distant from it. The outline of the work was shown up very distinctly, and the gun laid with perfect accuracy.

The apparatus for use in sieges must be as powerful as it is possible to

get. This applies of course to all the purposes to which the light can be put. The only limit is arrived at when the apparatus becomes so ponderous as to be unmovable. But as an army cannot sit down in front of a fortress without bringing up its armament of heavy guns, one can afford to construct the apparatus for this purpose more heavily, and therefore more powerfully, than for other things.

IV.—ATTACK AND RECONNOITRING.

A recent writer, who has collected into one book all the possible uses to which electric lights can be put for war purposes—and who seems to have held a brief from a certain manufacturing firm for the purpose of advocating its use—has, it seems to me, been injudicious in puffing it beyond its merits. He has stated that it can be used in the attack of a position as distinguished from that of a fortress, and also in a reconnaissance in force by night. The employment of search lights for such purposes will no doubt be considered a somewhat hazardous proceeding. Depending, as one would have to do at the critical moment, upon the search lights for the success of the undertaking, the accidental extinction of one of them would probably seriously embarrass a portion of the attacking troops, while a total obscuration of all the lights by the enemy's fire, though difficult to achieve, would throw the whole force into confusion.

It is not probable that the defenders would be successful in accomplishing the complete destruction of all the lights, for there would probably have to be one to about every two hundred yards of front; and, as has been conclusively demonstrated at Lydd and elsewhere, they are extremely difficult to hit. If utilized in the attack of a position the apparatus for generating the light must be drawn by horses, for the noise of a traction engine can be heard a long way off at night, and would call attention to the attack. The employment of electric lights in the attack would certainly give the general in command a greater choice of time at which to make the assault, and will not limit him to the actual moment of dawn, which is a time when attacks are expected. Notwithstanding that there might be certain advantages in particular cases to be obtained by making an attack before daybreak by the aid of electric lights, yet it is expected that generals will for some time to come prefer to wait for the dawn.

I suppose the same remarks will apply to a night reconnaissance in force by electric light, with this addition, that as a reconnaissance in force is usually followed by a retirement under more or less pressure from the enemy, the time for actually displaying the lights for the purpose of reconnoitring would have to be all the more carefully considered, for it would be wholly impossible to make an orderly retirement after the reconnaissance was completed unless daybreak had intervened. Indeed I should not have mentioned the employment of electric lights for such purposes as reconnoitring and attacking if it had not been that the writer just mentioned had enumerated such employments amongst its possible uses. Many great and radical improvements and changes would have to be introduced into the apparatus before any attempt could be made to carry out such undertakings, even if they could be defended on tactical grounds.

V.—DEFENSE.

It is quite another matter when we come to speak of the use of the electric light in the defense of a position against an expected night attack. Here we are on certain ground again. There is nothing to lose by the search light and everything to gain. For it has been conclusively shown that the light can be so placed so as not only to reveal nothing of the defenders' position and movements, but so that it actually affords additional security to them by the depth of the obscurity which it casts over objects in its immediate vicinity, which are out of the reach of the beam. It has been already mentioned that the apparatus is extremely difficult to hit. This is on account of, firstly, the difficulty of estimating the range, even with tolerable accuracy; and secondly, because without special appliances it is almost impossible to aim at the light. As an instance of the deceptive effects of distance, it may be remarked that if the beam be directed on to the ground so as to illuminate a patch of ground between the defenders and the enemy, but sufficiently far from the latter, it appears to any one looking at the projector from a distance as if the light were situated immed iately over the patch of illuminated ground; and if the projector be elevated or depressed slightly, so as to cause the illuminated patch to advance or retire, it seems as if the projector itself were advancing or retiring. Owing to this illusion it is almost an impossibility, without cross bearings, to determine the range of the light if it is kept constantly on the move, as it would have to be when searching for an enemy in front; and even if kept steadily fixed his difficulty in estimating the range is very great.

At Okehampton, in 1888, 32 rounds of shrapnel shell were fired from an unknown range, which was estimated at 1680 yards by officers with range-finders and pickets with lanterns attached to them. In the morning they found the estimated range was 100 yards too great. Seven bullets passed through the mirror without doing any damage to the light.

With regard to the difficulty of aiming, it is of course impossible to look at the direct light on account of its blinding effect, and therefore it is impossible to aim at it in the ordinary way. Extraordinary methods of aiming, such as that by the shadows of the sights, or by using oiled black paper, are hardly likely to be resorted to by the troops engaged in the attack, even if the men could be taught how to do so.

The experiments at Shoeburyness in 1883, at Lydd in 1887, and at Okehampton in 1888, have given remarkable evidence upon this point. At Shoeburyness 120 rounds were fired in one night from Martini-Henry rifles at the electric light apparatus, at ranges varying from 950 yards to 400 yards, and only one hit was made. On the following night 120 more rounds were fired and 5 hits scored, and at the same time 75 rounds were fired from a Gardner gun, and only one hit scored. Later on in the same year 400 rounds were fired from a Gatling gun, with the result that 19 bullets hit the apparatus, but this was largely due to the fact that the telephone was used to inform the officer at the firing point of the results of his firing. It should also be remembered that the ranges were accurately known to a yard. At Lydd similar experiments were made. Ten marksmen fired 200 rounds at ranges of from 1000 to 600 yards, without effecting any hits; 500 rounds

were then fired from a Gardner gun at 1000 yards, with the result of one hit; and 250 rounds at 600 yards from the Gardner gun, with three hits. The guns were aimed by the shadows of the sights on a piece of white paper held behind the backsight.

In these experiments the light from the projector was thrown upon a plane mirror mounted on a pole. The mirror could be traversed or elevated from a safe position behind a parapet where the projector was placed. The mirror was a thin sheet of silvered copper stretched on a frame, and though pierced occasionally with bullets, the reflected light from it was as strong as ever. If opportunity offers in the defense of a position, the arrangements for displaying the light should be the same as those at Shoeburyness, Lydd, and Okehampton, the invulnerability of which has been so conclusively proved. It will be very seldom that an extemporized shelter cannot be made for the projector. Something similar to a charger pit is all that would be required. The light is thus worked under cover, all that is exposed being the thin stretched metal mirror mounted on a pole, duplicates of which could be easily and cheaply provided in case of accidents, and could be substituted for the broken one in about a minute.

The best position for the light, if there is only one of them, would probably be in the centre of the front of the position, from which point the beam could be made to sweep either flank as desired. It is found that observations can best be made from positions at some distance to one flank or other of the projector, because the intensity of the beam of light is so great that it illuminates the particles of fog or smoke in the atmosphere to such an extent as to dazzle the eye of an observer placed close to the projector. By fixing the light in the centre of the line, the defenders on the flanks would be in the best position to resist the attack; and as the flanks of a position are generally tempting to the attacking general, this disposition of the light will usually have the best result. The centre would moreover be protected by the obscurity cast on it by the light, and by the fact that the enemy would hesitate to cross ground so brilliantly illuminated.

The principles on which a search light should be employed in the defense of a position in the field differ in many important respects from those on which it would be used in the defense of a submarine mine field or channel at night. The rules laid down as applicable to coast defenses must therefore be considerably modified before they are brought to bear upon field search lights.

It is impossible in the defense of a coast to employ boats adequately to fulfill the duties which correspond to those of the picket and patrols of a field army. Their communications with the shore would always be maintained at great risks, and they could not transmit intelligence with sufficient rapidity to be of much service. The enemy may be supposed to possess accurate charts of the positions of the fortifications against which they intend to deliver their attack, so that the exposure of the light will not give them more information than they already possess. In order, therefore, to do their duty properly, the search lights when used in coast defenses would naturally be kept continuously burning during the night, so as to discover the enemy's movements as soon as possible, and to enable the defenders to

make preparations to resist him. On the other hand, to utilize the light to the best advantage for field defenses, it should *not*, as a general rule, be kept continuously burning all night. It is not to be expected that it will relieve the pickets and patrols of the necessity for their usual vigilance, and if it is continuously displayed it will afford the enemy a beacon to steer by, whilst they are out of range, and so mitigate one of the most serious difficulties of a night attack. The light should not be shown until the enemy has been reported, and when he may reasonably be presumed to be within reach of the defenders' fire. The effect of a few well-directed rounds under such circumstances at predetermined ranges will be immense, especially as the enemy cannot be expected to have succeeded in maintaining a rigid formation during the latter part of his night march. The defenders will have the advantage of noting where every shot goes and the result of every volley, whilst the enemy will have no idea of the effect he is producing. His infantry will even be unable to aim, because they will see nothing but the light, and if they fire at that they will be unable to see the sights of their rifles.

Perhaps you will permit me to make a few remarks upon the necessity for caution in drawing conclusions with reference to points which present themselves as unfavorable to the employment of the light in defense operations. When a demonstration has to be made and experiments are being tried with the search light apparatus, under novel circumstances, and in the presence of critical witnesses, it is almost impossible to get people to appreciate the difference between defects which are inherent, and defects which are due to remediable causes.

For instance, if anybody feels inclined to combat my assertion that the electric light can be so placed as to reveal nothing of the defenders' position, and yet afford him a clear view of the enemy; and if he has before his mind the results of the trials made at the North Camp Redoubt during the manœuvres of the 2d field column last July, and to prove his point intends to call witnesses to say that the light did on the contrary reveal the outlines of the redoubt at certain times, I can reply that if properly manœuvred it would not have done so, and that all that occasion proves is the necessity for more care on the part of those who were directing the light. On the occasion referred to, the light was traversed through too wide an angle, and, before the advance on the redoubt had been begun, it was actually at one time pointing with its back to the enemy, and therefore, possibly, did reveal some portions of the redoubt; while, however, the advance was being made, I think everybody agreed that the redoubt was quite invisible.

With respect to the limit of visibility of objects illuminated by the electric search light, different observers have maintained discordant opinions. So much depends upon the state of the atmosphere, as regards clearness and dryness, that it is almost impossible to secure the same limits on any two separate occasions. The background and color of the object also makes a great difference. Moonlight assists the light very materially. Under favorable conditions I think small bodies of infantry may be detected with ease at 2000 yards, but more generally the useful limit is reached at 1500 yards. In a climate like that of England we have the worst possible conditions of visibility, not only on account of the fog, which is almost invariably

present to a greater or less degree, but also on account of the variability of the amount of invisible moisture in the atmosphere at different parts of the range. Where this invisible moisture in the air varies at different spots, as it would do if a stream traversed the path of the beam, the light is more intercepted than it would be if the air throughout were homogeneous. On the Continent and in dry climates the nights are generally much clearer, and the usefulness of the search light correspondingly greater.

VI.—REQUISITES FOR PRODUCING THE LIGHT.

The things required to produce a search-light are:

1. A Boiler.
2. A Steam Engine.
3. A Dynamo.
4. A Lamp.
5. A Projector with condensing mirror.
6. Certain small accessories.

Now several attempts have been made to render search lights independent of the necessity for carrying about a steam-engine and boiler by employing primary batteries instead, but unfortunately a thoroughly suitable primary battery, capable of rough transport over uneven ground, and easy to maintain, is still a thing of the future.

Lights worked by primary batteries have been tried at Aldershot and Chatham, not with any hopes that the light obtained would equal that produced by means of dynamos, but in order to determine whether the saving in weight and time from there being no necessity to carry about a boiler or to get up steam, is worth the loss in efficiency and power; but except, perhaps, for very small lights, the question must, I think, be decided in the negative. For the present I think it must be accepted that engines and dynamos form the most efficient means of generating the current of electricity, and are on the whole far preferable for actual rough wear. These engines can either be made locomotive, that is self-moving, or can be drawn by horses. We are, I believe, the only army who make use of the former for portable search-lights, whilst nearly all the continental armies have introduced engines drawn by horses. Messrs. Aveling and Porter, of Rochester, have, I believe, made very light traction engines with dynamos for the Russian Government, but I do not think they have been definitely adopted, for the only account of the Russian portable equipment I have succeeded in getting states that the apparatus adopted is the same as that of the Germans. Whether the traction engine principle will continue to be adopted for our portable field lights is a question that has still to be decided. There are many points in its favor and few against it, and the real difficulty lies in determining whether the few points against it outweigh in importance the many in its favor. The points to be considered in arriving at a decision are the following, viz.:

1. Facility of transport by road.
2. Amount of transport required for coal, water, etc.
3. Time occupied in bringing the light into action after reaching its destination.

4. Facility for moving across rough and soft ground.

5. Facility of movement of engine, etc., to give light at different points, or for sudden withdrawal.

6. Weights to be carried, including engine, apparatus, etc.

If one could be certain that it would never be necessary to transport the apparatus over soft ground or across temporary bridges, I should unhesitatingly declare in favor of steam traction, for the following reasons:

1st. Steam traction is unquestionably superior to horse traction for heavy weights over hard ground on any gradient passable by ordinary wheeled traffic.

2d. By its means a much more powerful light (and power is of supreme importance) can be carried about.

3d. It will be seldom or never that necessity will arise for moving the light more quickly than at the rate of about five miles an hour.

4th. The amount of coal required to be transported is less than the amount of forage required for horse transport for an equal power of light, unless the average length of the march is over 28 miles a day, when the fact of a horse's rations being so much per day, while the engine's rations are so much per mile, renders horse transport more economical in that respect.

5th. It economizes in horses, and makes the transport of the electric light independent of the circumstances which might cause it to be deprived of its means of locomotion if horses became scarce and more important stores required transport.

But the points against it, though few, are of great importance. They are, 1st, that it is hopeless to try to take it over soft or boggy ground, such as the baggage train crossed in its advance to the camping-ground at Deer Rock Hill, near Barossa, during the manœuvres of the 2d Field Column last year; and 2d, that it cannot cross temporary bridges, or even some permanent ones. For these two reasons the traction engine had to be left at Blackwater on the occasions just alluded to, for the only passable roads to Deer Rock Hill led across the wooden bridges in the grounds of the Staff and Military Colleges, over which the engine could not be taken.

Now an equipment drawn by horses *could* have been taken to the camp, because firstly, the weight would have been less; and secondly, because it could have been distributed over more pairs of wheels. A traction engine must be heavy or it would not draw heavy weights, and further its weight must be concentrated on one pair of wheels for the same reason. Also, it is well known that horses are capable of a supreme effort in an emergency, while it is just in these very emergencies that the traction engine breaks down, and the more it tries to extricate itself from a boggy piece of gronnd the deeper does it flounder. Recourse must then be had to planks and lifting-jacks, and this is a question not of minutes but of hours.

I think, therefore, that of lights intended to accompany the march of an army, two sorts are necessary; one a traction engine equipment, and the other a horse equipment. The first would always be used where possible, on account of its greater power and penetration, and the second should be used whenever the first cannot be brought to the point required.

It may be interesting to some if I give a short description of the equipments of foreign armies.

VII.—FRENCH EQUIPMENT.

The latest French equipment (for there have been several) is made by Sautter Lemmonier, of Paris. It consists of two four-wheeled carriages. On the first is mounted a tubular boiler, on the system of Dion, Bouton, and Trépardoux, a Parson's steam turbine, and a dynamo specially constructed to be used with the turbine. The whole weighs only 3000 kilos., or about three tons, with coal and water. Considering the small weight of the apparatus, the power of the light is very good, but it is only about half that which can be produced by the traction engine used last year. Steam can be got up in twenty minutes. The second carriage supports the projector, the lamp, two drums of double cable, each 100 metres long, and other accessory apparatus, including a telephone for directing the light from a distance. This wagon weighs 2.7 tons loaded. Each wagon requires four horses. The projector can, if necessary, be dismounted from the wagon and carried by means of two iron poles upon the shoulders of four men to places which are inaccessible to the wagon.

Messrs. Sautter Lemonnier have made various other types of apparatus of various powers, and designed for special requirements. One set is carried on one four-wheeled wagon, and another is carried on a four-wheeled wagon supplemented by a two-wheeled cart.

There is also an equipment intended for pack-saddle transport in mountainous countries. This was designed for the Austrian war in Herzegovina. I do not know whether it was actually used during the war, but they appear to have felt the want of it. It is characterized by extreme lightness and by the possibility of taking it to pieces for mule transport. No portion of it when thus taken to pieces weighs more than 220 lbs. Of course in the clear dry atmosphere of mountains a small apparatus, such as this must necessarily be, may be able to penetrate into the distance almost as far as the larger ones used in ordinary warfare, as the limit of distance is entirely governed by the purity of the atmosphere. The fact of so much pains having been taken in bringing out this mountain equipment shows the extreme importance assigned on the continent to the possession of search lights on all occasions.

VIII.—THE GERMAN EQUIPMENT.

The German equipment is made by Mr. Schuckert, of Nürnberg, in Bavaria, and has been adopted by the governments of Germany, Belgium, Italy, and others. Like the latest French equipment it consists of two carriages, one for the generating apparatus and the other for the projecting apparatus. The first wagon is entirely of iron and steel, and carries the boiler, engine, dynamo, and accessories. It is supported on four wheels with broad tires. One pair is 5 feet in diameter and the other is 3 feet. The wheel base is 9 feet 4 inches, and the track 5 feet 3 inches. The whole weight of the wagon with coal and water is 4 tons, of which 2⅔ tons are carried by the hind wheels, and 1⅓ tons by the fore wheels. The boiler is of a vertical multitubular type invented by Krauss of Munich, having 180 steel

water tubes. For the sake of lightness, the pressure at which it is worked is 180 lbs. to the square inch, which is well up to the safe limit. The peculiar conical shape of the boiler is designed to secure as large an evaporating surface as possible. In small boilers working high speed engines this is a great point, as it tends to subdue the commotion going on inside when steam is being generated, and so to prevent water spray being carried over with the steam into the engine, which would injure the engine. The funnel is provided with forced draught to facilitate the maintenance of steam at the required pressure.

The engine consists of four single-acting cylinders working on the same crank. It is called the "Abraham Motor." Without going into details I may say that it is most carefully designed to run at a high speed (700 revolutions per minute) without any of the knocking and jarring of the parts incidental to engines working with double-acting cylinders. It is coupled direct on to the dynamo without the intervention of either belting or gearing of any sort. The wagon takes 4 horses on roads and 6 horses on soft ground.

The second wagon carries the projector and lamp, 600 metres of double cable, and other accessories, and weighs when loaded about 2½ tons. The projector itself is lighter and more easily handled than the French one, and is provided with a mirror capable of collecting more light.

IX.—ITALIAN EQUIPMENT.

The Italians have provided their army with a search-light company, which is part of the company of specialists belonging to the 3d Regiment of Engineers. They have tried both the French and German equipments, and on the whole prefer the German, though they were far from satisfied with the Schuckert mirrors, which they stated did not penetrate so far into the distance as the French mirror under the same conditions. Mr. Schuckert has, however, modified the details of his mirror in accordance with suggestions made at the School of Military Engineering, Chatham, with the result that they are now the best in the market. The Italians have organized 7 complete sections of portable search lights, and intend to increase this number to 12. They used search lights successfully at Massowah and at Saati in 1888 and 1889.

X.—RUSSIAN EQUIPMENT.

The Russians have apparently not made so much progress as other countries in the matter of portable search lights. Their most recent orders have been given to the French firm of Sautter Lemonnier, while at the same time, as I have already stated, they have bought some traction engines fitted with dynamos from Aveling and Porter, of Rochester, which, though much smaller, are similar to those adopted by ourselves.

XI.—ENGLISH EQUIPMENT.

As regards our own preparations in this respect, I do not think we are yet fully alive to the advantages and importance of possessing portable search lights for field operations; and it has been my principal object on this occasion to try and show, not only that it is important that we should

be so equipped, but also to show that in some respects foreign countries are ahead of us. Many experiments have been tried in England with search lights of various degrees of portability, but as yet there has been only a part of one equipment recognized for field operations, and that is the steam traction engine and dynamo exhibited at the manœuvres last year. There is yet no special vehicle for carrying the projector. I maintain that, valuable as the traction engine is, it is not enough, and that we must also have a lighter apparatus for horse transport, for the reasons stated in a former part of this paper. We cannot do better than adopt one of the two continental types, at any rate till a better one is produced, because they have thrashed out the subject in a most thorough manner, and their productions are the result of years of trial and error, and are likely to be the best and most complete that can be obtained.

DISCUSSION.

Lieut.-General Sir Evelyn Wood: I want to indicate a point on which I should be glad if some of you will express your views. It has been said that no vote has ever been gained in the House of Commons by a speech, and I am still on the opposite side to-day, though I am thoroughly convinced that no one could have put the case for the electric light more fully than the lecturer has done. I found the electric light of inestimable value at Kafr Dowar, and I never went to sleep at night without throwing the light in the direction of the enemy to see if he was moving; and I had the same precaution taken several times during the night to make sure there was nobody moving outside the Egyptian lines. We did not know at that time how inert the enemy was. Is there a battle since 1859 in which the electric light could have been used by the aggressors? I do not say—Is there a battle in which the electric light was used by the aggressors? because that could be answered at once. It might be said it was not used because we were not sufficiently advanced. But has there been one battle fought within our memory in which the electric light could have been used by the attacking force with advantage? Perhaps some of you will tell us your views; I am possibly wrong. But I should like to know if you could use it, and if you could ever get it up without being discovered in a night attack. The object of such an attack is of course a surprise. Now the noise of the engine alone would be heard long enough before you reached the enemy by a quick-eared scout. And then there is the unavoidable noise that would be caused by the pulling of horses.

Colonel Lonsdale Hale said: I asked a question on one occasion as to whether the electric beam would penetrate Col. Crease's smoke. Some people seem to think Col. Crease's smoke a fad. Now I have seen it tried at Portsmouth, and it is not a fad. At present the apparatus is somewhat cumbersome, and if Col. Crease can reduce it to portable proportions, it will become a potent factor in the attack on a position. In the course of the experiments at Portsmouth, a body of men advanced within 200 yards of a position unseen under cover of the smoke. I bring this forward in connection with the electric light, because it is important to consider. Sir Evelyn Wood took me to the other side of the Fox Hills when the electric

light was being tried, and I thought, if we have this smoke cloud, which can be made very portable, it will render the electric light comparatively useless in the field for search purposes. I think the smoke is one of the difficulties that Major Hippisley should have dealt with. With regard to another point mentioned by a previous speaker, there are very few battles carried out at night. If, instead of inquiring whether the electric light can be used for attacking purposes, we consider its uses on the battle-field for the purpose of finding where the enemy is, I think we shall find that it may be uncommonly useful. After the battle of Coulmiers the defeated rested within a stone's throw of the men who had won the field. If the electric light had been there to search, the defeated enemy might have been pounced upon again, but in the absence of cavalry they did not know that the enemy lay at their feet.

The Chairman: (Field Marshal Sir J. Lintorn Simmons, G. C. B., G. C. M. G.) I have listened to this lecture with the greatest interest, but I think there are some points which require serious attention before electric lights are adopted for active operations in the field. I think there may be great danger attending their adoption, because of the tendency to trust to them instead of advanced outposts. Tel-el-Kebir is often quoted as a night attack that might be copied. On that occasion the enemy had no outlying pickets whatever, at least I think not, but only an outwork that was unknown to the assailants. The march on that night was undertaken under favorable circumstances. There were no hedges or ditches to be met with; yet on the march the troops very nearly came to a disaster; I am told that the wings closed upon one another, while the centre did not march so rapidly, and the men came almost face to face, and by God's mercy the attack did not fall upon the outwork, and the enemy was surprised in his position. Then night attacks are very dangerous, and should not be undertaken except under the most favorable circumstances. When the country is thoroughly well known, when the enemy's position has been reconnoitred, and the troops are well trained, night attacks may be successful, but they will always be attended with enormous risks. The troops, when they arrive at the position, will be unusually fatigued, and they may perhaps have been alarmed by scares in the night, so that they could not be depended upon in the same way as in daylight. Major Beresford speaks of electric light as likely to have great moral effect. I do not believe in the moral effect of the electric light if used for purposes of attack. It might assist troops in defending a position, but I do not think it would assist troops one atom on the march, even if they did not warn their enemy of their movements. It is very difficult to advance with machines weighing three or four tons. As for four tons being drawn by four horses you may as well try to move this hall with four horses. Four horses could not move four tons over heavy ground, and even on a newly macadamized road they could not move such a weight. You need not, however, be afraid of locomotives. Although they could not pass over the bridges spoken of just now—the bridges near the Staff College—still they are capable of going over rough ground. Several years ago I saw eight or ten different kinds of locomotives tried near Birmingham. The course marked out was about a mile

over hedges and ditches and across ploughed fields. In the hedges openings were made a little wider than the engines, the earth being thrown into the ditches. The locomotives were started and went over the fields and ditches; it was quite an interesting steeple-chase across country—(laughter). Some of them stuck fast in the ditches, but the majority did remarkably well and got to the end of their journey. Locomotives are good both for short and long distances; they are reliable and do not get out of order as quickly as horses, and their "forage" is not so difficult to procure. There is another important consideration in connection with the electric light as a search light. When used for coast defense there is the sea—a great expanse of level plain—before it, the light being capable of being thrown a very great distance without meeting any obstacle, whereas on land it is seldom that it will act under favorable conditions, that is over a plain in which there are not undulations or hollows sufficient to conceal large bodies of troops; even an observer in a balloon could not discover troops by means of the electric light if so placed. I will now ask you to accord a hearty vote of thanks to Major Hippisley for his valuable and interesting paper—(cheers).

LETTERS ON ARTILLERY.

By PRINCE KRAFT ZU HOHENLOHE INGELFINGEN.

Translated by Major W. L. HASKIN, U. S. A.

XVIII.

REPLIES TO CRITICISMS AND QUESTIONS.

YOU know but little of me if you think it possible that I am irritated by the objections, replies and questions which your letter contains. They prove to me how carefully you have re-read my collected letters upon artillery in order to have acquired the general impression of my opinions upon this arm which the whole work produces.

These opinions must be very badly founded if I cannot suffer the expression of differing ones, and this would show in me a lamentable deficiency of proof in support of them. I reply to your objections and questions the more readily as the former have arisen from statements of mine which might easily be misunderstood, perhaps also out of an inexact manner of expression on my part.

The questions give the opportunity to fill up deficiencies, and I ask indulgent criticism upon the fact that such deficiencies clearly do exist; for I write as I would talk and without regular plan, in order not to bore my readers with a pedantic classified system.

1. Your chief objection is *to opening fire at 5000 metres.*

I grant that this stands upon a weak footing, because it rests entirely upon deduction; and I acknowledge that I have never seen field artillery fire at 5 kilometres.

But, I have no reason to doubt the accuracy of the tables giving the results of actual firing which are added to the Regulations of 1877, and from them it appears that at that range half the shots fired struck within a rectangle of 8½ metres by 55 metres. So long as this fact is not confuted in actual practice I am constrained to admit that the artillery effect at 5 kilometres is worthy of notice, as I did at the beginning of the Twelfth Letter.

When the country in front of the enemy's guns is wholly open so that no shelter can be found nearer to him, an effective result with half the projectiles thrown is well worthy of consideration, and we may be forced to begin the artillery combat at quite 5 kilometres. My words must not be so interpreted as to mean that I recommend that the whole force of the artillery should always be brought out at 5 kilometres. I thought myself protected from this by the whole tendency of my writings, for I have repeatedly recommended always *to go as near as the circumstances will permit* at the beginning.

But I wish to be understood as pointing out the fact that under certain circumstances we cannot forbear from beginning the struggle at these great distances, and I think it necessary to state this that we may not be taken unawares when the occasion comes.

Should such an occasion arise we must bring to bear a preponderating number of guns in order to be able to get nearer and to occupy more decisive positions.

At the time of the smooth bores a range of 1200 paces was not more considerable than one of 5 kilometres is now. Yet cannonading by great artillery masses took place during the wars of 1813–15 even at 1800 paces.

I cannot reject the conviction that such cannonading will happen now at 5 kilometres, and from the foregoing facts I must express this conviction.

I grant that I should have expressed myself more cautiously and should have said: "In country which is perfectly open and plainly seen it will be necessary *sometimes* to open the artillery fight at from 4 to 5 kilometres, since the powerful shrapnel carries even to 3500 metres;" instead of, "We are required now to commence artillery fire at from 4 to 5 kilometres, if the field is open and plainly visible, since the powerful shrapnel carries even to 3500 metres."

I ask you not to stick to the letter of the text, but to take hold of the sense and spirit of the whole.

2. You object also to the principle which I lay down, that *as much artillery as possible should be brought early into action* and say that it is not right to deprive the rear divisions of their artillery in order to bring it into action separately at the front. In regard to this last named point I am wholly of your opinion. I do not reckon it among the "possibilities" to deprive the infantry divisions of their artillery.

The artillery of a division is an integral part of it. The commanding general cannot take it away.

"So much artillery as possible" means the reinforcement of the engaged artillery of the leading division by the corps artillery.

In my opinion the separation of the artillery from the infantry of its division should always be avoided. It is only when the division commander has the conviction that his artillery is as much a part of him as his infantry battalions are, that he will be apt to look carefully after it, and will cease to consider it as only an appendix about which he need not concern himself. Only then will the infantry and artillery work together in cordial and useful coöperations.

It will certainly happen here and there in the fight that the artillery will be wholly separated from its division, but this is always a misfortune, just as it is unfortunate for an infantry battalion during an action to get away from its division.

It should be avoided if possible.

The artillery of the 1st Infantry Division of the Guard was so separated at St. Privât. It could not be avoided. The division had sent forward its artillery to open the battle, and it was in action. I reinforced it with the corps artillery and was obliged to place this on its left because on the right the space was required for the Hessian artillery. Even while the battle was being opened by the artillery almost the whole infantry of the corps in rear of the line of battle was drawn off into the hollow towards Ste. Marie aux Chenes.

General von Pape then occupied this position, and, later, when he went forward against St. Privât, his artillery not being with him, I shared the batteries of the corps artillery with him for the purpose.

That was an evil, but the necessity arose through want of time. I could have sent after him his own artillery from the right wing, but there would have been a great loss of time, since it was the farthest off.

Such evils happen, but, since they *are* evils avoid them if possible.

3. In the same manner you have wholly misunderstood me when you censure me because I would *allow the artillery of the defendants*, when the assailants are getting the upper hand in the artillery duel *to let their guns from time to time be silent* and to draw back under cover in order to reappear unexpectedly at the critical moment; for you fear that this would exercise an unfavorable moral effect upon the real infantry defensive battle.

Throughout the whole course of my letters stretches itself in red letters the opinion that the artillery is never to leave the infantry at the pinch. The momentary drawing back of the artillery under proper shelter cannot for an instant be presumed to take place at the moment when the infantry is closely engaged in the defensive battle and needs encouragement,—technical and moral assistance. It is a matter of course, and I have repeatedly asserted, that then the artillery has to hold out so long as the commander will hold the position.

The time of which I spoke could only be that in which the artillery duel only is going on, and in which the infantry is not yet energetically engaged. When the infantry, later, enters into the defensive fight, another phase of the combat begins in which the artillery again comes forth, and assists with all its energy, and in which it must hold out to the last man.

I experienced one such withdrawal and return to action. It was at St. Privât. We had about 60 French guns opposed to us. They became silent

and withdrew after an artillery duel which continued a long time. When our infantry went forward to the assault and masked our own guns, the French batteries reappeared and joined their fire to that of their infantry. They surprised us by it in this action, for we had believed them to be reduced to silence.

You think it will not always be possible to find shelter so near that the artillery could come from it to the right spot at the critical moment. Then the artillery must have selected a poor position and it cannot go back under cover.

For I observed explicity that a rolling back of the guns a few steps behind the heights upon which they stand would be sufficient. All artillery that cannot obtain cover in this way must remain at the front, that it may be on the spot to support the other arms at the right time. Attention to its own cover.—sparing itself,—its own security,—all these are of secondary importance.

4. Your objection to my views of employing *horse artillery in cavalry actions* proves to me that there is no real difference in our opinions.

Speech—at least my written speech—is too poor to express all that I mean to say without leaving deficiencies and without leaving a possibility of a misapprehension.

Against my assertion in the Twelfth Letter that the artillery will of necessity have to silence the enemy's far reaching artillery, you say that it is not permitted to betray the attempt to surprise by using the artillery prematurely. Of course you are wholly right *when* we can hope to surprise the enemy.

When possible we push under cover as near to the enemy's cavalry as we can, with cavalry and artillery, use case and shrapnel, and make use of the disorder so caused for an attack of which the result is certain and in which the enemy's guns will fall into our hands.

Yes: the case is even imaginable in which the cavalry advances wholly without its artillery in order to be able to surprise.

But I cannot base any tactical principles upon the rare occasions when the enemy would commit such great tactical errors. I have considered only the regular ordinary occurrences and cannot take into account such exceptional ones; for then I would never have come to an end; particularly in the discussion of cavalry fights where the quick changing situations permit an endless number of combinations. I must assume that the enemy knew as much of us as we of him. He will hide his cavalry in the hollows of the terrain as we will, and the artillery will begin the fight in order to make it possible for the cavalry to come out of cover.

You object when I say "that does not prevent us from opening upon the enemy's cavalry when it comes within range with at least a part of the artillery" and prove then that such a division of fire must not be permitted.

I also cannot permit it.

You have not noticed that I wrote "*at least* with a part" signifying thereby that as a rule the whole artillery must fire upon the cavalry as soon as such firing will be effective. This is in accordance with the statement following the one in question and with that contained in my Seventeenth

Letter, for it is the rule for all artillery to open upon other troops as soon as they are seen to be within effective range.

When I wrote those words "at least with a part" I had in mind that the enemy could send a small force upon the flank of such a cavalry division, perhaps a squadron, during the cannonade, and in such a case it would be right to disperse or drive it back with a few good shots, and not necessary to break in upon the artillery fight of the whole line.

I turn now to answer the questions you ask, which will give me occasion to fill up the deficiencies which I certainly have left.

A. *What is the limit of the authority of the commander of the troops over the artillery; and is it necessary to allow more latitude for the independent action of artillery than for the other two arms?*

I deem it extremely hazardous to set an exact bound at any time to the authority of the common superior.

Discipline would be endangered thereby as was the case formerly in the artillery.

I described this to you in my seventh Letter, upon "*L'esprit de caste.*" The artillery itself would suffer from it, for it would be estranged from the commander of troops if the obedience due his orders were limited by fixed bounds.

The harmonious working together of the different arms;—their mutual, tactical, seasonable aid;—must thereby suffer. Only by the most intimate connection of the artillery with the other arms can the desired effect be produced, and only by the most intimate connection between the three can their full fighting powers be developed.

They must obey implicitly whenever the common commander orders. He may go into details as much as he chooses. They must not only obey the text of the command but must enter into the design of the commander with a readiness to advance it,—an initiation in obedience.

When the artillery commandant,—be it of a division, or of an army corps,—by his obedience, his readiness, his aid to the other troops in fight, has won the confidence of his commander; the limitation of the common chief comes about of itself, through the mutual understanding and through the confidence of the superior.

According to the individuality this will differ. But when harmony fails between these personalities; when the inferior makes pretensions for himself,—when he holds back and awaits orders instead of going for them,—when he criticises these orders at decisive moments and executes them unwillingly,—when he presumes to go out of his own province;—then harmony will be interrupted, and then the limitation of authority does not furnish a remedy.

In the whole course of the War of 1870–71 I never experienced the necessity of limiting the authority of a commander of the troops so that the usefulness of the artillery might not be prejudiced. Individuals were very different in this respect.

In the 1st Infantry Division of the Guard the greatest confidence prevailed between the division commander and his commander of artillery. This confidence increased in the course of time, through the genuine worth of both, to a kind of intimacy.

General von Pape said only to Lieutenant-Colonel von Bychelberg, "My design is so and so, direct the batteries accordingly." But other occasions happened when the General ordered, "Bring the batteries here quickly," and it was done. Lieutenant-Colonel von Bychelberg had commanded the same batteries with the same division since 1866 and enjoyed the greatest confidence of the other arms.

With the other division it was different. The artillery commander changed several times in succession by loss or substitution. General von Budritzky knew but little of their military capacity. Moreover, this general interested himself very much in the artillery, with which he had once served a year, and interfered very much in the details. During the siege of Paris I met him often as he sought positions for his batteries, and he overlooked the building of the emplacements himself. He often personally designated the objects of fire, and regulated the rapidity of the firing.

I have never seen any interruption of the harmonious working of the troops result from this. The general ordered and the artillery obeyed. On the contrary I was a witness once when the general, after the storming of Le Bourget on the 30th of October, 1870, warmly thanked an artillery staff officer for his assistance.

If I tell you of my experiences with a commanding general, it will make this matter much plainer.

The chief of artillery of an army corps has really no troops to command. He is tactically only the artillery advisor of his commanding general, from whom all orders issue. If he himself gives an order he can only give it in so far as he is authorized to use the name and authority of his commanding general. He takes command of the real firing artillery line only when more than half of the artillery of the corps is engaged, and only then if the commanding general permits it.

Usually I rode with and remained near my corps commander, Prince von Wuerttemberg. That made the reciprocal working easy.

The Prince required my opinion upon the time and place for bringing the batteries into action, then issued his orders in agreement therewith, or otherwise, and I sent my adjutant in his name. Of course it was permitted me to make suggestions concerning the applying the artillery if he had the time to listen to them.

He agreed with them or declined them, according as his intentions would be furthered thereby or not. In the course of time the cases in which he declined to follow my suggestions became more rare because I could more easily divine his intentions. But still it happened now and then, as at Sedan, where I, at 11 o'clock, wished to push the whole corps artillery, and that of the 1st Division nearer to the enemy.

The Prince would not consent because it was necessary about this time to move the 2d Infantry Division of the Guard more to the left to the support of the 12th Corps.

He ordered the battalion of horse artillery to be pushed forward in the centre, to fill the void between the two divisions. This order was executed more quickly than the Prince believed possible, and this increased his confidence in the artillery.

Even after this there sometimes came to me definite artillery orders from him. As at the moment of alarm caused by the sortie on the 21st of December 1870, when the Prince told me in my lodgings to send a battery immediately from such and such a division to Dugny and to point out to it the place it should occupy; which order I of course obeyed instantly.

I would not therefore advise that bounds should be set to the authority of the commander of the troops, and if I were required to propose such I would have the greatest difficulty in determining the proper limits.

Probably you say "the commander of the forces has tactical questions to determine and should not meddle with the technique of the artillery." That would upset everything.

One commander says to his artillery commander, "I wish to assault this village. Prepare the way." The other says "Bring the batteries upon this height and cannonade this village; I will then assault it." It must still be left for him to decide to what extent he will depend upon the effect of the artillery.

Even in technical details interference must not be forbidden him. He must be able to order "Concentrate all your fire now upon this wing of the enemy, we have information that masses are assembled there for an assault;" or it must be permitted him to direct a change in the place of the ammuition column in the train, in order that it may be able to reach him if he needs it or he must be able to move the ammunition wagons from their selected position if he needs it for troops. There are more of such cases.

It seems to me that the regulations now existing with us reach far enough, and I would not wish to alter them. They provide for the unlimited subordination of the artillery commander to the commander of the troops, and place him with the commander of the troops until half, or more than half of his batteries are in action. That moment will define the beginning of his independent action.

I cannot agree that the artillery requires more latitude for independent action than the other arms do. On the contrary. In most actions the artillery is placed at the point from which the best view of the field is obtained, and upon this the commander of the troops has naturally placed himself. It results from this that the infantry troops are the most extended and the farthest removed from him and that he must allow them a certain independence of action, while on the contrary he can always command the artillery.

Take the case of the cavalry. It is always far off, either when it scouts miles distant at the front; or, when covered by one of the wings, it awaits the proper moment for attack, which it must lose if no independence of action is allowed it.

So it was in the last war.

The Prince von Wuerttemberg remained in the vicinity of the Corps artillery, (even, as at Sedan, between the guns) except when he had a better observation point, or rode along the ranks of the passing infantry, as at St. Privât, to animate them.

Generals von Pape and Budritzky were always to be found with their artillery except in the crisis of the infantry fight, as at St. Privât, or as when

Budritzky rushed forward with the storming party at Le Bourget. "Yes," you probably say, "but what if the commander of the troops does not understand artillery?" Then say I, "suppose he does not understand the management of infantry, because he happens to be a cavalryman?" We cannot base rules upon such exceptional cases, any more than upon the case in which the commander-in-chief suddenly goes crazy, as the unfortunate Kaminsky did in 1806; or on the case where the leader is an ignorant barbarous butcher, as the Jacobin Legendre was in the war against La Vendée at the time of the French Reign of Terror.

We do not knowingly trust divisions and corps to leaders who are not familiar with the management of the three arms.

B. *What are the details of bringing a mass of artillery into action,—in what relation do the commanders stand to each other; what are the duties of the artillery commander?*

I cannot give you definite rules in reply to these questions. I can only tell you how these matters were regulated in the battles and actions in which I took part.

In consequence of the order of march which we adhered to in the War of 1870–71, (Corps artillery behind the leading division) forming up artillery masses was, in the offensive, quite easy.

When, at St. Privât the head of the corps was saluted by the enemy's fire, the commanding-general, after the enemy's position had been reconnoitred, desired the advice of his chiefs of the general staff and of his artillery commanders. We all advised to order up the Corps artillery at once, for we counted 60 guns opposed to us. Meanwhile the four batteries of the leading division (the 1st) trotted up to go into action. I have already written you (Sixth Letter) how Colonel von Sherbening came trotting up at the first cannon shot and appeared upon the ground just as the general commanding ordered him to be sent for. He had simply marched alongside the 1st Division on its left. The last battery (2d Horse) went into action at a galop. I believe that not more than a quarter of an hour passed between the first cannon shot of the leading battery (1st Light) and the first shot of the last battery (2d Horse.) There were in all nine batteries which went into position as quickly as possible. The Prince von Wuerttemberg halted to let them pass him. When the 8th battery neared him I remarked to him, that I now, according to regulations, should be at the front (we had 15 batteries in the Corps). He gave me permission and I rode on with the 2d Horse Battery.

I announced to Gen. von Pape (1st Division) through an adjutant, that I had been directed to take command of the artillery firing line and from that moment the artillery battalion of the 1st Division lost its connection with its division and came under my orders.

Later the 2d Infantry Division of the Guard came upon the field with an infantry brigade and three batteries (the other brigade and one battery had been detached to the support of the IXth Corps.) Gen. von Budritzky sent these three batteries into action on the left of St. Ail upon the left wing of the nine batteries which were already engaged. Later still the commanding general directed the cavalry division to send to the Corps artillery both the

batteries which were attached to it and they also took position upon the left wing. There the fourteen batteries fought as one grand battalion, in the following order from the right. The first Foot Battalion; 2d Foot Battalion; Horse Battalion; and on the left the three batteries of the 3d Foot Battalion.

As a point of observation from which to overlook the guns I selected a little rise of ground about twenty paces in rear of the limber horses, almost at the right of the Corps artillery and on the left of the 1st Foot Battalion. From this point I sent my orders by staff officers, or hastened personally hither and thither wherever it was necessary. After the storming of the height, in which I accompanied the 2d Heavy Battery, I remained, as I have already written you, behind the chief of the 4th Heavy Battery, Captain Seeger, and occupied myself with the details of the firing.

I obtained from him information as to the distance and sent it by adjutants right and left with orders designating the objects of fire. After the battle was over I sent the 1st Battalion to its division, after which it had to remain in battery on the front line until day-break.

The harmonious working of the artillery and infantry in action becomes more difficult from the moment when the artillery commander is no longer with the general commanding. I sent an adjutant to him from time to time, in order to be sure of carrying out his intentions. He was stationed somewhat to the rear upon a height which gave a better oversight than our position did but which was deemed too far distant for the best artillery effect. I would have done better to have left the adjutant wholly with the commanding general with no other orders than to advise me immediately of any change in his intentions.

At Sedan this matter was regulated in a plain and easy way.

We were aroused from our encampments and bivouacs at 3 o'clock in the morning. The divisions made use of different roads for the advance—the 1st Division on the right along the Ardennes,—the 2d Division on the left along the causeway by the Chiers River.

Upon leaving Carignan the commanding general ordered the Corps artillery to trot straight to the front upon Bourn St. Remy. Hitherto, the Horse Battalion had been attached to the Cavalry Division acting in our front and on the previous evening had gone into bivouac with it behind Carignan. I proposed to the Prince von Wuerttemberg to attach the Horse Battalion to the Corps artillery again for this day's battle. This was approved and I sent the order. The Horse Battalion set out from Carignan somewhat later than the 2d Foot Battalion. When the commanding general, at the front, had reached the height east of and overlooking Villers Cernay, the Corps artillery was ordered there through Francheval. The 2d Foot Battalion came, their horses covered with foam, upon this height, as the vanguard of the 1st Division was preparing to drive the enemy's skirmishers from the woods of Villers Cernay opposite.

At my request the commanding general permitted me to dismount this battalion to allow it a little breathing time, while I rode forward and reconnoitred the ground, where I met General von Pape, as I have before written you. At his request I hastened the advance of the artillery attached to

his division and went to the commanding general to obtain permission to reinforce it with the Corps artillery. The advance into line was slower than it had been 14 days before, because of the steep slopes and heavy soil. But when the batteries were in action the general guidance became much easier, inasmuch as the commanding general remained either between or in the batteries. I was much in motion between him and the artillery battalions and carried orders to the division artillery "in the name of the commanding general."

Not until he gave me authority to lead the whole line of 90 guns forward into the last position, and I had in view this hazardous manœuvre (of which I have written you and which was successful),—not until then was it that "I took the formal command." *Then* I announced to the division commanders that I had orders to take command of the artillery, and they then *detached* their artillery commanders and *placed them under my orders.*

This last formality is an absolute necessity, and I believe it should always be observed, otherwise it would easily occur that the artillery would receive conflicting orders from the two sources.

This must always be avoided. When troops have more than one chief over them the greatest confusion arises; collisions, conflicts of authority, and uncertainty. No man can serve two masters.

After I had taken command of the artillery line at Sedan, communication between the commanding general and the division commanders became easier than at St. Privât, for the latter stood between or near the guns, and I could easily confer with them and then obtain the orders of the general commanding.

I have never taken part in any defensive action as an artillery commander, for the result of such actions as the sortie of Le Bourget, etc., was that we always took the offensive; but I think that the handling of the artillery in the defensive must be much easier than the bringing it into position in the offensive from the march.

Sometimes when I have imagined myself called to the defense of some one of our besieging positions against a sortie, the proper management of the artillery appeared to me to be very plain.

The batteries stood in positions selected by the artillery commander with the approval of his general, and these positions were constantly made stronger and stronger, and the batteries, in case of a sortie directed against their positions, had only to direct their fire upon the enemy's troops. But, because we always took the offensive and advanced from our defensive positions until the enemy was forced to retreat under the cover of his works, it is proper to call them offensive engagements so far as relates to the part taken therein by our troops.

The formation of the masses of artillery; the relations between the commanders; and the duties of the artillery commanders; were nearly the same as at St. Privât and Sedan. I would only tire you by going into particulars.

It happened to me once to be in an action in which only one division was engaged, and to be on the artillery firing line without having received the command of the artillery. In such a case I must not interfere or presume

to give orders, but must confine myself to giving advice, and if the artillery commander shows me an order of his division commander which conflicts with my advice, then I must acquiesce.

During the march I rode as a rule with the general commanding. Besides my proper functions I had to attend to filling the deficiencies among the officers, men, horses and munitions, and these orders were published in the daily general order and sent out in writing from the bivouac or quarters after the march.

During marches these daily general orders followed always immediately at the end of each day's march, before dismounting, and before the troops went into cantonments or bivouacs, through the chief of staff of the corps, who first obtained for them the approval of the commanding general. This chief of staff had held a similar position during the campaign of 1866 also, and had an established routine of these matters. He always dictated the orders to an adjutant at the writing table. Finally, before the dictation had been read over and collated, he inquired of the several chiefs,—of divisions, artillery, trains, etc., whether there were still any matters to be arranged, and at this moment I brought forward my propositions for the artillery, if any were to be made. I had to overlook the fact that the chief of staff was my junior in rank, for in war the interest of all must set aside all questions of etiquette.

It was necessary for the efficient discharge of these duties that I should make special inspections of the artillery and ammunition columns. This I could only do under the authority of the general commanding and only on the days on which the information furnished by the cavalry in advance made it certain that no action would occur.

Then I either remained behind or rode forward on the march. Usually I rode to the troops to be inspected, after the march, upon a fresh horse.

For my inspections of the divisional artillery, an order of the commanding general was necessary, which I obtained for that purpose. Therefore no conflict of authority, or collision, ever occurred. No definite regulations existed to this effect, but the practice developed itself in a natural way from the *Ordre de battaille.*

The execution of these details was easier than it has the appearance of being from the written explanation, for as a rule I found the division commanders of artillery with their division commanders.

C. *Where is it best to place the main body of artillery in the different formations for attack, and what should be said concerning the fire of artillery over infantry?*

It is very doubtful whether it is possible to fix upon a definite place which the artillery must take when it supports the fight of the other arms.

This holds good for a battery which is attached to a regiment or brigade, as well as for the artillery of a division or for the main body of the artillery of an army corps.

Definite rules can only be determined upon the supposition of acting upon a perfectly level plain, which in practice never happens. Therefore the results so obtained apply to no concrete cases, but, if formulated into rules, serve only to entangle the ideas. In practice, on each occasion on

which its effect has been in some measure relied upon by the different arms, the place for the artillery has determined itself from the terrain, in connection with the progress of the action, so absolutely, that no doubt could exist concerning it.

Firing over the infantry by the artillery is always an evil because it is apt to produce a bad effect upon raw troops; but *it cannot always be avoided.* Infantry which has been in action several times becomes accustomed to it. At the bombardment of Montmedy, on the 5th of September, 1870, after the battle of Sedan, I had to fire over a line of sharp-shooters established for the protection of the batteries on the edge of the plateau eastward of Thonelle near the fortress. The infantry amused themselves with and jested upon the shells which whistled over them here and there. Presently they wearied, for they had just made a night march, and there they slept in the stubble field so soundly that I found it necessary to send forward other men to awaken them in the event of the enemy's approach.

It is easy to say that the artillery should be stationed upon the flanks, but that is often impossible, especially when it is between corps.

I have already mentioned to you how much it is to be desired that the first échelons should be placed by the side of the batteries at first.* That gives a front of 200 paces for battery, and of 3800 paces for the 19 batteries of an army corps if the ground is such that all can come into line. The fighting front of an army corps cannot well be of greater extent.

At St. Privât the ground in which the Guard Corps must fight, from the left gun of the Hessians to the right gun of the Saxons, measured 3800 paces (see the battle plan for 5 o'clock P. M. in the history of the war by the general staff); and at Sedan the distance was nearly the same from the right wing of the Saxons to the right wing of the Guard Corps. Therefore it will in many cases be necessary to fire over the infantry. So we fired across the Givonne, where, deep down, the Fusileers and Chasseurs of the Guard were posted.

I have already written you something upon this subject and have emphasized the fact that peril results to the infantry only when our material is defective so that shots burst in the bore and come out as canister; or when the artillery stands so far back that it cannot distinguish friend from foe.

Artillery should therefore not fire over infantry when it is stationed too near it in rear (it should be at least 500 metres from it); nor too far behind it,—I think not beyond 1000 metres.

If infantry must assume the offensive between the guns, then it will mask them until it has won several hundred paces of advance, and during this period the guns must cease firing. If this cannot be avoided it is a misfortune which must be taken into account and a factor which must be considered in arriving at the determination to attack. This will be the moment when the enemy will allow his guns to re-open if he has at times kept them silent.

I can here answer yet another of your questions upon the position of the great artillery masses which hastened up to the support of the Infantry

* The first échelon consists of three caissons and a store wagon.—*W. L. H.*

of the Guard of the XIIth Corps, when these troops were from time to time checked in their advance. In many places the batteries stood 600 or 700 paces behind the infantry line which was firing lying down. Where the infantry line was very slender the batteries unlimbered in the skirmish line so that the skirmishers lay in the intervals of the guns. It was so with the 2d and 4th Horse Batteries of the Guard with which I stood.

D. *Is the aiming by means of an object in rear of the guns of any practical utility?*

I have never been present at any such practice. From the description, it is to be employed when the object aimed at is hidden by the cover (forest, copse, hill, etc.,) behind which it is necessary to remain in order to escape annihilation while coming into battery within shrapnel range. Then the guns are to be aimed backward over the sights upon some point which gives the proper direction, the elevation being given by the quadrant. An observer placed upon a height makes known the effect and the necessary corrections are then made.

I can easily imagine the case in which this manner of firing succeeds, and then the important result is obtained that the enemy receives an effective fire while he knows not whence it comes and can neither see nor reply to it.

I have a lively recollection of how unwelcome, at the siege of Paris, were some of the enemy's shots, when their guns were so concealed that we could not see them, and therefore remained long in doubt as to the direction and elevation with which to reply to them. But it must not be forgotten that from such a hidden position the practice is more difficult and requires more time than when the object can be aimed at directly, and furthermore, that in this method of procedure, changes in the aim, and practice upon moving objects, appear certainly to be excluded.

Such a concealed position can only be used for the beginning of the short range artillery duel; and when the enemy's fire is somewhat subdued, it will be necessary to go to a position from which a view is obtainable in order to be able to act in case of other eventualities, particularly in the event of the probably immediate assault of the advancing infantry.

Through the difficulties attending the practice with artificial point of aim so much time may be lost that this new position may be reached too late. Then this method of action has only done harm.

I think therefore that this is an ingenious theory which in very few cases will accomplish what is expected from it.

In conclusion, there are yet two replies to be made to passages in your letter in which you express your disagreement with me.

First: you find a contradiction in that I stated in the Ninth Letter that I had placed, as a principle, the first échelon (3 caissons and one store wagon) on the left of and near the battery; and then declared that one caisson should be placed behind the 2d, and another behind the 5th piece, in order to be able to take ammunition directly from them.

I grant that there seems to be a contradiction here. In explanation I must state that when the battery took position the four wagons came upon its left and took position in prolongation of the battery front, with the

proper intervals, and with their horses toward the enemy. The captain commanding meanwhile obtained the range. So soon as the firing was begun he looked after the supply of ammunition and then placed one caisson behind the 2d and one behind the 5th piece. The 3d caisson remained upon the left of the battery with the store wagon. I think it better to station one caisson behind each half battery rather than one behind each platoon because otherwise all the caissons of the 1st échelon would be emptied at the same time and would all have to go to the rear to fill up. The batteries would therefore be for some time without caissons and would be forced to take ammunition from the gun limbers until the relieving caissons come forward from the second échelon.

TWO BRIGADES.

From the German of CAPTAIN FRITZ HŒNIG.

BY CAPTAIN PAUL ROEMER, U. S. A.

(*By permission of the publisher, F. Luckhardt, Berlin.*)

(Continued from No. 53.)

IV.

PSYCHOLOGY AND TACTICS.

THE power which guides masses is the will. The means to aid the will is discipline. The essence of tactics consists in the union of psychology and form. We must always remember that tactics has to deal with thousands of men and that all, though individually of different character, have the natural egoism which incites to preservation of life. There are times when the great mass is seized with a desire for war as in 1870. But such circumstances are exceptional and must remain so as long as the doctrine holds good that national wars are only possible when the individuals of a country are inflamed by national pride, love of country and patriotism. If the injury to national honor—violation of territory, etc.,—were equally felt by every man as a disgrace and outrage, and if all were affected by the sense of honor to demand satisfaction, offering body and life in support, then tactics would be based upon the best foundation. But this is only possible in dreams. Even when all souls have been inflamed with patriotism the enthusiasm of the mass dies at the threshold of death, egoism conquers idealism ; physical weakness, power of mind and the desire to live conquer the will to offer life.

The number will be small who can pass through the exertions, privations, reverses and disappointments of a long war with the same enthusiasm, courage and determination. We know from our own experience that these forces change like the state of mind, the disposition of the body and the atmosphere in which we live. There is a limit ascribed to soldierly courage by current theory. In the school of war the man gathers his experiences,

the leader exercises his moral, intellectual and physical powers. In war courage will not increase in the mass but only in the few. These few, officers and men, are the soul of the command. The most courageous soldier is the one who has stood under fire. With him the habits of the drill-ground may become so strong that he acts in battle for a time as if on the drill-ground. But only for a time, only so long as he remains unconscious of the danger into which he has been brought. No sooner does he become aware of it than apprehension for his life takes hold of him. In no other way can we explain—psychologically—the sudden halt of advancing troops than that the danger of the situation has become clear to them. These are the decisive moments. There are few who have the power and energy to reanimate the vanished courage of the troops and carry them forward. The brigade which carried out the attack on height 846 would scarcely attempt it again. No human power could have made them rise and advance after they had laid down. There is a limit in tactics, when the power of the will comes to an end and the influence of the leader has no effect. We should choose, therefore, tactical formations where the leader can exercise his influence as long as possible. We must not depend too much upon the enthusiasm, courage and determination of the individual, but remember that the mass is and remains inert. Where is an officer of experience who will assert that it has cost him no trouble to leave cover in order to storm across an open field under a terribly destructive fire? Who has not seen the order and call of the leader ignored? Who has not seen, when an officer sprang forward, only a few brave fellows rush after, a few more follow slowly and the greater part not all? Who has not seen an advance come to a sudden halt when the leading officers were killed or wounded? We have soldiers behind us, not heroes. To-day it is not only difficult to prevail upon the several divisions, skirmishers, züge and companies to leave their shelter and charge across a space swept by mass-fire, but the maintenance of control has become more difficult.

As forcible examples, we have chosen the two attacks—Probus and Mars-la-Tour—which resemble each other in many respects. But while at Probus the control over the division, brigades, battalions and companies was never lost, while the commanders were always to be found in the first line or with the supporting troops, while the connection between the leaders and men was never interrupted, at Mars-la-Tour the whole brigade was deprived of the control of its higher leaders from the very beginning. What was practicable upon a battle-field of the same character four years before could not then be carried out within effective mass-fire of breech-loaders, and will be impossible in future under similar circumstances.

If the knowledge of the weakness of human nature demanded formerly in all fire-tactics the control and influence of the officer as long as possible, how much greater are the demands of this tactics to-day when already at great distances the material and moral effect of mass-fire has increased so much. And as human nature with all its weaknesses remains the same, it follows that the tactics of to-day demands a higher degree of knowledge and skill, of initiative and energy, of perseverance and intelligence; in one word, tactics has become more psychological.

Attacks across an open field like those at Probus, Mars-la-Tour and St. Privât will remain an exception, and still more exceptional will be the case where an isolated brigade will be thrown against an impregnable position as at Mars-la-Tour, at least without employing a part of its force against the enemy's flank. A front attack under such circumstances will never bring about a decision without the assistance of other troops on the right or left; and as surely as the 38th Brigade was overthrown by the enemy posted in a strong position, so surely would the Guard-Corps at St. Privât never have stormed the village, in spite of superior numbers, if the XIIth Corps, by moving around the French flank, had not brought about a decision which could not have been attained in front.

The troops who attack in front must bear the greatest losses, must persevere under a destructive fire to let others gather the palm of victory. Their ranks become thinner with each moment. The enemy may take advantage of the first favorable opportunity to rush forward and crush them. Under such circumstances one can see how much troops can accomplish and how far demands upon them may be carried. They must not lose their *morale*. To prevent this is the duty of the leaders who must also preserve the physical powers of the men. It is not the greatness of the losses which speaks for the moral worth of the troops but the attitude they assume under adverse circumstances. In other words, tactical worth depends upon moral power and these again are closely connected with physical endurance. What the Guard-troops at St. Privât accomplished, because their physical powers were not exhausted, was not attainable by those of the 38th Brigade, even if their force had been greater, because they were physically used up.

RULES, EXAMPLES AND CONCLUSIONS.

The Guard-Corps at St. Privât showed that control over troops can be maintained under unfavorable circumstances.

From this we draw the following tactical maxims. (For a Brigade.)

1. To consider human weakness which prefers a covered to an unsheltered position.

2. To choose formations which offer to the enemy unfavorable targets.

3. To increase the rapidity of movement when advancing over spaces covered by the enemy's fire.

4. To employ formations which admit of great rapidity of movement with least exposure; these favor the influence of personal example in officers and the maintenance of discipline.

5. To avoid frontal attacks across open country.

6. To remain in motion as long as possible without stay or halt, taking advantage of every shelter the ground affords, but not to lie down before arriving within at least 400 yards of the enemy's position.

7. To prevent troops from firing as long as possible and to begin only when it becomes a moral necessity.

8. After the first halt of skirmishers, the brigade remains in motion, and as soon as its first deployed ranks reach the skirmish line, the skirmishers rise and the line thus reinforced is carried forward by the moral influence of

command and drums beating the charge. It advances eighty metres at double time. In the meantime the brigade follows, with the brigade and regimental commanders in the third line. The skirmish line again reinforced is thrown forward another 80 metres. Now it is within 240 metres of the enemy. A steady, brisk fire is maintained, skirmishers are more and more reinforced; the second and third lines regulate the intervals and distances lost in the advance. Volleys are fired at word of command until the arrival of the third line.

9. The employment of all forces—except one half battalion per regiment to gain the decision.

10. The movement is prepared and supported by energetic artillery fire. The beginning of the advance is an important moment and the enemy's infantry the principal target—distance 1600 metres.

11. If the attack succeeds, the two half battalions and artillery follow, the former join the first line, and the troops who are not under fire, assemble without delay.

12. If the attack fails, the artillery fire increases, the two half-battalions deploy, eventually the cavalry charge if opportunity offers, and the defeated infantry assemble as near as possible to the enemy's position.

This is a scheme, unsubstantial perhaps like all others, but we have taken pains to base it upon the weakness of human nature. We believe that it will find favor with those who know human nature, and that in the hands of able leaders it can be employed with success.

Like most German officers we have, since 1871, seen only manœuvres. In peace practice many things differ and must differ from the realities of war, and it seemed as if now the nature of the country, rather than human beings, was to play the most important part in tactics. We were convinced of this at the great autumn manœuvres of the VIIIth Corps in 1877. It seemed as if it was the intention to make war bloodless, and the tactical bodies of infantry appeared like groups of marionettes who were pushed up, moved forward, pulled down and shoved on again. What can be said of an attack where the assailant begins and keeps up a lively fire combat at a distance of 1000 metres, rising, rushing forward, lying down, etc., and this under the enemy's mass-fire? This was repeated at a signal perhaps eight times. Does any one believe that the same men will do this twice in actual war? We think not. Does any one who has studied human nature and its many weaknesses, imagine that advancing and firing at the same time, when still at great distance from the enemy, will lead to success?

The assailant wishes to conquer. To do this he must first approach the enemy and then open fire. We do not condemn the use of shelter but it must be used properly. We must remember that every attack will cost blood and much blood. The men must be educated to understand this.

The history of wars shows that, before the introduction of breech-loaders, attacks upon strong positions cost as many lives as in the war of 1870–71. The Prussians lost at Collin 40%, at Zorndorf 38%, at Kunersdorf 40%; the French at Borodino 30%, at Aspern 50%; the Germans at Mars-la-Tour, the bloodiest battle of that war, 22%.

This shows how erroneous is the idea that wars have become more bloody since the introduction of breech-loaders.

The greatest mistake that we have observed in all our tactical studies is this, that we take exceptions for rules, that is to say, we always take open country, which can be covered by an effective infantry fire at a distance of 1600 to 1800 metres, for illustration. This has given us wrong ideas of tactics.

Attacks with great bodies of troops, such as brigades and divisions, across an open country, will remain exceptions.

We do not condemn all regimental practice in open country, but we are of opinion that a brigade once launched on open country cannot be controlled. If such an attack succeeds, the brigade is saved, if it fails, the brigade is annihilated, if the enemy is capable, and we seek in vain for tactical formations in such a case.

Destructive fire at great distances necessitates the reduction of greater bodies into numerous lesser ones by diminution of front and extension of depth.

But the most flexible formations together with the best fire-arms cannot force a victory. No success can be expected when the attack comes to a stand-still and a fire combat is taken up at a distance of 1600 metres from the enemy. The "how" and "how near" is the question.

If a front attack cannot be avoided, it is best in our judgment, not to engage in a fire combat at great distance but to gain ground as rapidly as possible and halt within 400 metres of the enemy, engage him with a heavy fire, which must be conducted with great energy, and await the effect of the attack on the right or left, or on both wings. The advance should be made in deep columns, under cover of a heavy line of skirmishers, each company column with files broken from right and left to rear. The troops in such a formation can, under most circumstances, be kept in hand.

If the 38th Brigade and the Guard-Corps could have made their attack in the manner described their losses would have been decidedly smaller. In attacking, the principle of firing only when there is a certainty of hitting will always remain the correct one. This certainty begins with 400 metres. Having approached the enemy within such a distance, the fire combat must be carried on with the greatest energy. That troops under able, energetic leaders can be led within this distance we consider as possible. If the infantry is compelled to halt at the distance named, the artillery must come to its support as it did at St. Privât and Sedan.

No infantry attack can be successfully conducted without sufficient artillery.

In the German army 12 pieces to a brigade is the minimum and we think a maximum of 4 batteries in battle about right. At the decisive points of the battle-field it is necessary to place strong lines of artillery to prepare with its mass-fire the advance of the infantry. The latter will do the rest provided it is led by determined, capable and intelligent leaders.

If we cannot establish a tactical system entirely suited to all circumstances, still we can adopt tactical formations which are fundamentally correct and which can be adapted to most circumstances.

For example:

At 2000 metres the brigade* forms in three lines in company columns, the columns closed.

At 1600 metres, four züge are deployed as skirmishers, two from the 2d and two from the third company of one battalion, the other züge of the 2d and 3d company are placed behind the flanks of the skirmishers, the 1st and fourth company behind their centre.

At 1200 metres, the 2d züge are deployed behind the flanks of the skirmishers and the company columns are opened with an interval between every two files.

At 800 metres, the 4th and 1st company are extended, each in three züge, 80 metres from the skirmish line and equally divided behind it, to act as a moral support along the whole line. The company commanders are in the centre and have a drummer with them.

At 400 metres, the line halts—heavy fire from both companies of each battalion. The rear line remains in motion. As soon as the züge of the 4th and 1st company reach the skirmish line, the command "Rise!" is given and with beating drums the skirmish line advances 80 metres at double time. The züge follow. This is repeated as previously stated.

At 240 metres the first line halts and its two battalions open heavy fire. The second line, two battalions, advances into the first, opens volley fire and keeps it up until the 4 companies of the Fusilier battalions arrive behind this line, now composed of four battalions.

All advance now at double time. The four companies of the two Fusilier battalions prepare to support.

In this manner, after the artillery has shattered the enemy, must the first line be continually reinforced from the rear.

These formations are a combination of line and column which, it is true, have not all the advantages for firing possessed by the extended line, but they are easier to control and the commander's personal example and discipline can exercise a stronger influence over the men.

In describing the details of the attack of the 38th Brigade, we have shown that closed lines and larger columns, whole or half battalions, were not practicable. In some cases the formations and conduct of the troops in the 2d and 3d line must depend upon the tactical intelligence of the leaders. The higher leaders cannot be everywhere and the battalion and company commanders must understand their business.

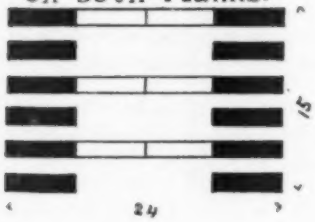
The following six figures show the formation of companies 180 strong without non-commissioned officers, etc., which can be adapted to almost any circumstances. The occasion when they are to be applied depends upon the judgment of the company commanders. The 2d and 3d line of a brigade, for example, can employ all six at the same time if circumstances demand it. A company of 180 men has 3 züge of 60 men each or 30 files—a front of 24 metres. The advantages and disadvantages of these formations can be seen at a glance.

Troops should be exercised in these movements, from company up, with

* The brigade has two regiments, the regiment three battalions, the battalion four companies and the company three züge. (P. R.)

Deep column.

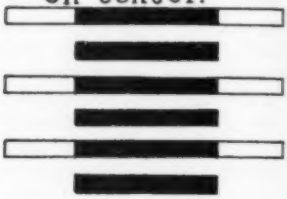
On both flanks.



On right flank.

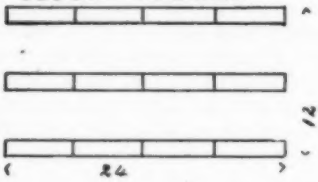
On left flank.

On center.

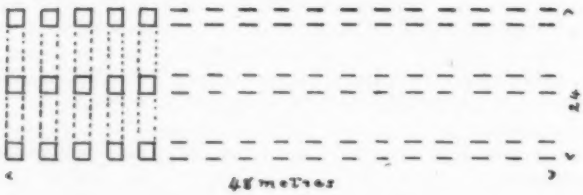


Company.

Closed column.



Open company column.



the greatest rigor and care. Instead of wasting precious time in insipid, senseless exercises and dull, slow, stupid drills; companies, battalions, regiments and brigades should be taken out into the open country and marched from 1600 to 2000 metres over obstacles, through woods, ditches, etc., in advance, to the rear, in quick time, double time, to the right and left, changing direction, etc. Great attention must be paid to the preservation of formations. Under certain circumstances officers might disappear just to see how the troops would act.

In these exercises officers should carefully observe the conduct of the men, to see how far discipline, control and order can be maintained.

But this is not enough. Brigades must be trained in time of peace to pass through any description of forest and ravine in close order. Care must be taken that the brigade does not crumble away in passing through the forest so that on emerging it can move out united and advance to the attack in good condition. We have not learned anything from our experience in the forest of Maslowed and the Bois des Geniveaux. Hardly a single battalion passed through the latter maintaining its tactical connection. And why? Because they were sent in in extended order. Reinforcements followed in the same manner and for hours we stood on the brink of ruin, while back in the woods were men in crowds, a mixture of different regiments—useless tactical bodies.

A brigade that understands how to pass through a forest in tactical order and can move out on the other side united and under control of its leaders is well prepared for war.

It will be hard to overcome in our army (German) the affection for the dispersed order. But as long as we adhere to it we will never arrive at a true development of our attack formations.

The dispersed order sunders all tactical bonds, renders confusion and the mixing up of units unavoidable and is directly opposed to combined action. Generals become superfluous.

In the first part of the War of 1870–71 captains and lieutenants did the work. Battalions, regiments, brigades, divisions and even corps were mixed up regardless of consequences. At the first shot everybody rushed to the front. Battalion, brigade and regimental commanders were for hours without a man at their disposal. Division commanders were not better off. Corps commanders were in luck if they could dispose of more than a few small battalions. The battles in August 1870 were fought in this manner. In truth with such tactics we need only lieutenants and soldiers. Away with this kind of individualism, it will be the death of our tactics.

We say that these tactical blunders took place in the first weeks of the war. Weissenburg, Mars-la-Tour and St. Privât are examples. But already at Beaumont we had acquired correct tactical formations and often defeated the enemy when numerically our superior as at Beaune, 1 against 6; on the Lisaine, 1 against 3; before Le Mans, 1 against 3.

In the details of the attack of the 38th Brigade we believe we have shown that our company column tactics, if intelligently applied, would have sufficed, even under the most unfavorable circumstances imaginable. Can the last man be brought in closed order nearer to the enemy than at Mars-

la-Tour? There is no other example in the whole war where the opponents, so to speak, ran into each other.

The proof that the enemy can be approached under the most unfavorable circumstances is therefore practically given.

That the brave troops succumbed was not altogether due to faulty tactical formations. Before such a strong position and superior numbers every minority will break down, no matter what the tactical formations may be.

Let us take care to develop in every man the will to approach and conquer the enemy. Le us endeavor to arouse in him the psychological powers, fidelity, submission, force of will, enthusiasm, love for country, etc., then will our company column tactics not remain unrewarded. Let us avoid in all attacking movements, halts, lying down, etc.; let us keep back our fire as long as possible.

But how about persevering after approaching the enemy? As we have seen in the examples of Probus and Mars-la-Tour, much depends upon the tactical formations, the time and manner of advancing. Should the attack come to a stand-still, its force will be broken, but the troops will not be lost. The Guard Corps at St. Privât held its position for three hours under a destructive fire without retreating. The 38th Brigade, without infantry or sufficient artillery support, persevered for half an hour within 80-100 metres of the enemy. If it had been supported by heavy artillery fire, who knows but that it might have been successful. We oppose those who assert: "No troops can hold out in one position under a grazing fire; they must either advance or retreat." They must persevere at critical moments; if they do not, they do not deserve to be called good soldiers.

The perseverance of the advance at Mars-la-Tour teaches that the moral education of the soldier must be carefully looked after, for it outweighs everything else. If brave soldiers in faulty formation did excellent work, how much better will they do it if given good ones.

There is not a case in the late war that can compare with the courageous attack of the 38th Brigade. The Guard Corps at St. Privât, although under powerful artillery protection, came to a halt at 500-700 metres from the enemy who was inferior in numbers.

Le Bourget and Skobelef's attack in the third battle of Plevna approached it, but do not equal it, because in both cases the general situation was more favorable to the assailant.

Now let us look at the material side of the attack.

If the greatest military glory consisted in the loss sustained, then the 38th Brigade could claim it. Of all German organizations it suffered the greatest loss under fire and this in the shortest time. The event is therefore from a moral, physical and tactical point of view equally characteristic and remarkable.

That we desire to see whole companies deployed as skirmishers in the first line, we have clearly stated.

That our companies must be divided into three züge and formed in two ranks, is indisputable. As a rule, there will be present from 50 to 80 men in each zug. That the centre zug is the guiding one is a necessary rule for such a company.

This zug must have a company flag posted with the officer in command of the zug. With its help he may communicate his intentions to the commanders of the züge to his right and left. The flag replaces the mounted officer in the firing line. Any one who has passsed through a war will know what it is to remain mounted under a heavy fire. The bodies of the many fallen staff officers, adjutants and company commanders at Mars-la-Tour showed the exact position of the several companies. As far as we could ascertain only three mounted officers remained unhurt. It was the same at St. Privât.

In time of peace the dismounting must be practiced at all fire-drills and the men must know that it is done by order. They are then prepared for it in time of war and it makes no bad impression upon them.

The difficulties with which the higher leaders have to deal are great and they must be reduced as much as possible by the aid of the thorough tactical education of the inferior leaders.

The brigade commander will have about completed his principal task when, after having described the object of the attack in definite terms, he has arranged the tactical formations of the brigade and after carefully watching for the proper moment, has seized it and thrown the brigade into action. The rest must depend upon the progress of the engagement. It will be difficult for the brigade commander to meet unlooked for circumstances unless he has divided his brigade into three lines and retained the control of the third line.

During the engagement all the brigade commander can do is to encourage the attacking forces through personal exertions and to employ the third line for the charge at the right moment or make it useful as a reserve. He should unfold his designs in a short and precise manner to regimental and battalion commanders. Tactics as well as responsibility demand this. Then it will not happen, as it did at Mars-la-Tour, that in the whole brigade nobody knew what was really to be done.

Before Plevna, as well as at Mars-la-Tour and St. Privât, whole regiments, which endeavored to advance in large columns, were swept away. The same thing happened at the Shipka Pass to the army of Suliman Pasha whose front attacks were carried out in a still more senseless manner.

All this does not speak so well for the effect of mass-fire of infantry at great distances; it rather illustrates the injudicious employment of large columns under such a fire. Under certain circumstances we must not disregard its material effect, and under all circumstances its moral effect.

But we might put the question: Were the French with their determined and intelligently planned attacks on Vionville against the 6th Division, more successful? Did not this division which could only carry on a close fire combat, and with inferior numbers, put 8000 of the French *hors de combat?* This splendid result was not altogether due to the fire tactics of the German infantry, but rather to the correct tactical application of the three arms. It is this which is so little regarded in the contest against mass-fire, while it should be at all times the ultimate end of all tactical effort.

We must concede that the Imperial French army was tactically well

trained, and we freely acknowledge that no troops could have displayed greater energy in a fight.

To judge correctly the tactical efficiency of two opposing armies they should be equally well trained and educated. The French armies organized later under the Republic were greatly inferior to the Imperial troops.

The German troops held Beaune-la-Roland, Bapaume and the Lisaine against greatly superior numbers and mass-fire.

The attacking French troops at Mars-la-Tour and St. Privât, suffered greater losses than we did, and in spite of their numerical superiority, met with no success, which must be attributed to their faulty tactical formations.

On the other side, the gallant behavior of the German troops of the II Army in the many engagements against Le Mans in which, as a rule, small company columns were employed, teaches us what suitable tactical formation, energy, discipline and control over troops can accomplish.

Mass-fire at great distances cannot and must not be employed, as a rule. The nature of the country, fog, snow and rain will often make it impossible, and only in such positions and under such circumstances as at Mars-la-Tour, St. Privât, Plevna and in the Shipka Pass will it be of annihilating effect.

We doubt if the Germans and French will fight in the future as the Russians and Turks fought.

Every battle-field will compel us to deviate from proposed formations. Obstacles of all kinds influence tactical movements; they produce interruptions, derangements and irregularities. To overcome these, and in the many unforeseen circumstances, to keep clearly in view the means which lead to tactical superiority must be the aim of the tactical education of the leaders. Then the difference between mechanical and intelligent understanding of the situation, the true value of personal influence and individualism, as we understand it, will show itself.

If we take any innovation in a department of science, some men will always be found who will go into extremes regarding its application. In no department are faulty speculations so fatal as in that of tactics; we should, therefore, be more cautious in this than in any other.

The world has entered upon a new path. On account of the great improvements in arms, infantry fire at short distances has fallen into comparative discredit. After the splendid examples of mass-fire at short distances mentioned above, the principle: "Only to fire when certain to hit," has without good reason been rather put one side from the moment when fire-arms were adjusted to cover a widely extended zone of fire. "The probability of hitting" has taken the place of the "certainty of hitting"—quantity the place of quality.

After one great nation had introduced far-reaching fire-arms the others could not fail to do so. The moral factors, which in battle are always the most important, commanded it.

Now we must not overlook the fact that the principal thing is not the shot but the man who shoots; and that this man, in spite of higher intelligence, always remains the same in regard to natural egoism and natural inertia.

That our own and other nations have gone too far in regard to mass-fire at great distances has already been admitted. That circumstances will happen where it can be of value, provided it is executed at word of command (volley firing) is indisputable, but they will always remain exceptional. That when employed by the assailant it has very little material effect, and in return leads to loss of control and opens the door to all the weaknesses of human nature, that it leads to waste of ammunition and to scarcity at the very time when ammunition is most needed, is not to be doubted. That it has led us into a system of tactics in which the nature of the country is more considered than the man is the most ruinous of all its effects.

The troops must be kept in hand by their leaders, for only by this means can personal exertions, moral power, discipline and even habit come into full play; only then is intelligent initiative possible.

SUMMER EXERCISES IN THE RUSSIAN ARMY.

Translated from L'Esercito Italiano.

By FIRST LIEUT. T. C. PATTERSON, 1ST ARTILLERY.

THE special tendency to make much of the individual training of the soldier is thus commented upon by the editor of *L'Esercito:* "These exercises being intended to develop the military spirit in all its forms—rigid self-control, agility, dexterity, strength and boldness—it may be said that Russia, more than any other country, presents the spectacle of a perennial imitation of war and of continual practical experiments."

1. *Passage of a river by field artillery on rafts of limber chests and poles of carriages.*—At the divisional camp at Orel (36th division of infantry and 36th brigade of field artillery) various experiments were undertaken for crossing the river Oka, a tributary of the Volga, partly by the pioneers of the regiments, partly by a body of the troops with their baggage trains. In these operations the infantry made use of local means such as small boats, obtained by requisition in the neighborhood, poles, tables, etc. Experiments were also made with bridges composed of small boats constructed of a framework of stakes and covered with tent-canvas. These experiments, however, hardly fulfilled the object desired, which was to enable the troops to cross a stream quickly, making use only of the means which they always have at hand, and which form part of their equipment on the march; inasmuch as tables, boats, etc., may not be available or may be insufficient in number. The successful solution of the problem was that offered by the commandant of the 1st Battery, 36th Brigade, Lieutenant-Colonel Kociakidse, consisting in the use of a raft constructed of the poles and ammunition chests of the carriages of the battery. The crossing was made with entire success on the 27th of July (8th of August) by the battery of 4 guns, at a point where the Oka has a width of 62 metres and a depth of 3 metres. Twenty-eight cannoneers, together with the traces and surcingles, the picket-

rope and 6 limber chests emptied of ammunition and projectiles were required. The chests were dismounted from their axles and fastened with running knots, by surcingles and trace ropes, to a frame. This frame was constructed of six carriage poles and two target-frames placed crosswise, and to this the chests were fastened, one at each of the corners, the remaining two at the sides. They afforded a buoyancy perfectly within the limits of safety for the crossing of rivers, and the raft served afterwards for the crossing of the infantry.

The raft having been prepared on the shore and loaded with a picket-post and some axes, it was launched, one end of the picket-rope (64 metres long) being attached to it. All being in readiness, twelve cannoneers who were able to swim untied the raft and pushing it with one hand swam to the opposite shore. The commander of the camp, Lieutenant-General Dukonin, crossed on the raft on this trip. After having made fast the picket-rope the tackle was attached, the other extremity remaining at the point of departure where three men drew it back or slackened on it as required. On the second trip were transported the men's equipments, the harness, the axles, etc.; on the third, the piece dismounted; fourth, the gun-carriage; fifth, the ammunition, etc. The horses with their drivers crossed by swimming at the time of the first crossing of the raft.

The time required for the passage was one hour and fifteen minutes. It should be noted, however, that the crossing being the first of the kind made and without any auxiliary means, it may be claimed that with practice this time could be reduced considerably. A battery on a war footing using the 8 limber-chests of pieces, 1 from the spare gun carriage and 4 from the caissons, making two rafts instead of one, might require about 6 hours; a battalion on a war footing (800 bayonets) about 2½ hours.

2. *Passage of horse artillery on canvas boats.*—Another example of the crossing of a river, making use only of means always at hand, is afforded by the 1st Division of the Don Cossacks where several patterns of boats were tested, made of the men's lances and canvas. The most practicable was that proposed by an officer of the 15th Regiment of the Don Cossacks, consisting of a boat of about 738 kilogrammes burden, made of 16 lances covered with canvas. It has the form of a truncated pyramid; its construction requires only 25 minutes, the material used is a paulin and a few lances, and it is quite light, only 4 men being needed to carry it. The boat was tested on the 1st of August on the Bistrize, at a point 3 kilometres from Lublin, where the river is about 32 metres wide and from 2 to 4 deep. The experiment began with the crossing of the 10th Regiment of Cossacks. With this in view there were assembled near the place of the crossing 12 platoons of 16 files, or one for each sotnia of the 1st Brigade (9th and 10th Regiments of Cossacks), and 12 pieces of horse artillery. The 10th Regiment began by sending out scouts, skirmishers and pioneers, 96 in all. At the point of crossing these men dismounted, unsaddled and undressed; they remounted and carrying with them only their sabres, which they held between their teeth, entered the steam and guided their horses to the opposite bank. On account of the narrowness of the stream, and wishing to exercise their horses in swimming, the landing was made at a considerable distance down

stream, so that the distance traversed was 106 metres. The crossing was made in perfect order, the horses entered the stream readily, and the men remained mounted on the horses, holding on by the mane, while the saddles, clothing, arms, etc., were transported in two of the canvas covered boats. In twenty minutes all arrived at the further shore, where the men quickly dressed themselves and sent out scouting parties. After them the platoons of the 10th Regiment accompanied by the same two boats containing arms, saddles, and equipments, completed the crossing, dressed and formed in 35 minutes. At the same time, but a little higher up, on boats of the same character, but with a double covering of canvas, the experiment was made of crossing the guns and their carriages. after having dismounted the guns from their carriages and taken the wheels from both the gun carriages and limbers. In one of the boats, of which the bottom and sides were covered with hay to protect the canvas, were placed two wheels, and six Cossacks crossed in this boat to receive and unload the stores at the point of arrival. To the same boat was attached the end of the picket rope which was made fast to a picket post at the point of arrival. In this way the crossing could be hastened, as the men sitting in the boat and pulling on the rope could impart to the boat a little greater speed than could be obtained by using the Linneman intrenching tools as oars. In another boat were successively transported the gun carriage, the piece and finally the limber. Before loading the piece it was found necessary to fill the boat with a large quantity of hay. Therefore, when the last boat, containing four Cossack soldiers with the two remaining wheels, crossed, no hay was placed in the boat, and although the weight was much less than in the others, it was not so well distributed. It barely succeeded in crossing, sinking near the point of arrival, but as it was very light, two Cossacks were able to draw it up on shore.

To dismount, transport and remount the piece and limber, 40 minutes were required.

The same means were employed in the passage of the 9th Regiment, which was accomplished with the aid of two boats in half an hour.

The value of this experimental boat was so evident that the Commandant of the 1st Division of Cossacks gave orders for each of the six sotnias of the regiments to provide itself with a paulin for the construction of these boats.

It may be well to add that although the weight causes a heavy pressure on the lances composing the framework of the boat, nevertheless those with which the men of the 1st Division of Cossacks were armed, stood the test without breaking, being made of a kind of fir which is both flexible and strong.

Military Notes.

IMPENDING ALTERATIONS IN THE "CAVALRY REGULATIONS" (BRITISH).

THE following are some of the principal alterations in the new Cavalry Regulations which will shortly be published:

The pace of the gallop is 15 miles an hour. When Troops are moving at a gallop and a new formation is required, the heads of columns, etc., drop into a canter till the formation is completed, when the gallop is resumed.

2. In forming squadrons (*i. e.*, line) from squadron columns, as a rule the 2d Troop forms on the right of the leading Troop, the 3d and 4th Troops on the left. These Troops come up at an increased pace *at the incline*.

3. In forming line of squadron columns from Column of Troops, the 2d squadron moves on the right of leading squadrons, the remainder on the left.

4. What we have been calling Divisions are now called Troops. A squadron may be divided into three or four Troops; the strength of these Troops is not yet settled, but they are to be either 12 or 16 file, according to the number of men in the ranks.

5. In column, the rear rank is ½ horse's length from front rank; in line, it drops back to one horse's length.

6. Troop leaders are consequently always in front of the centre of their Troops, from which they are ½ horse's length distance in column.

7. In each Troop there are three guides (non-commissioned officers), one in the centre, and one on each flank, The centre guide always follows his Troop leader.

8. There is no turning the head in dressing, except at the halt or on the passing line. Men have to ride straight and keep their touch to the centre of their *Troops*, the general alignment and cohesion of the squadron being secured by the Troop leaders riding parallel with each other and at the proper intervals.

9. All wheels from the halt and all wheels on the move at a walk (with the exception, in both cases, of changes of direction of columns) are made on a fixed pivot. All wheels on the move at a trot or gallop and *all* changes of direction of column are executed on a moving pivot.

The radius of the arc described by the Troop leaders in changing the direction of a column of Troops should equal 1½ times Troop frontage, which in all cases in which the Troops of a squadron are wheeled simultan-

eously on a moving pivot as from line into column or *vice versa* equals Troop frontage. In wheeling, the Troop must move up to the ground from which the Troop leader commenced his wheel: the centre guide following in the Troop leader's track at the proper distance.

10. The leader of the centre, or right centre, Troop is termed the directing Troop leader. When the squadron leader personally conducts his squadron, he rides two horse's lengths in front of his leader, who merely follows him at the prescribed distance.

11. The moment a squadron halts, the Troop leaders correct their alignment or distance, the Troops conforming. The command "Dress" is not to be given unless a critical dressing is required.

12. The Double Column has disappeared from the drill book; it is under consideration whether ½ sections can also be done away with.

13. There are no bases given during field manœuvres, distances and intervals being taken from the directing squadron.

14. There are still two markers for the regiment, but their duties are to mark the passing line in parade movements, and to indicate the position to be taken up by the regiment in the assembly.

15. "Sections right, March." The right front rank section wheels to its right, followed by its rear rank at ½ horse's length, etc., etc.

"Advance-by sections from the right." Right front rank section advances followed by rear rank, remainder front rank sections wheeling to right, etc., etc.

"Retire by sections from the right." Right hand front rank section wheels to the right, again to the right, etc., etc., rear rank moving up to ground on which front rank section stood, etc., etc.

16. In diminishing the front on the move the word is "Advance by sections," "rear halt," when all but the leading front rank section will halt; in increasing the front the command would be "Form fours," "rear trot" as we have always done.

In forming Troops on the move ("Form Troops") from single files, etc., etc., each Troop leader gives the word "Rear trot" or "gallop," on which the head of the Troop continues the pace.

When the Troop is formed it is led at an increased pace to its place in column.

17. A "Mass" is in lieu of squadron columns at close intervals, the interval being two horse's lengths.

"Quarter column." Squadrons in column at Troop open column distance from each other and two horse's lengths, so that a wheel of Troops to either hand would change the order to that of "Mass."—*Journal of the United Service Institution of India.*

TARGET OF SPRINGFIELD RIFLE CAL. 0.30.

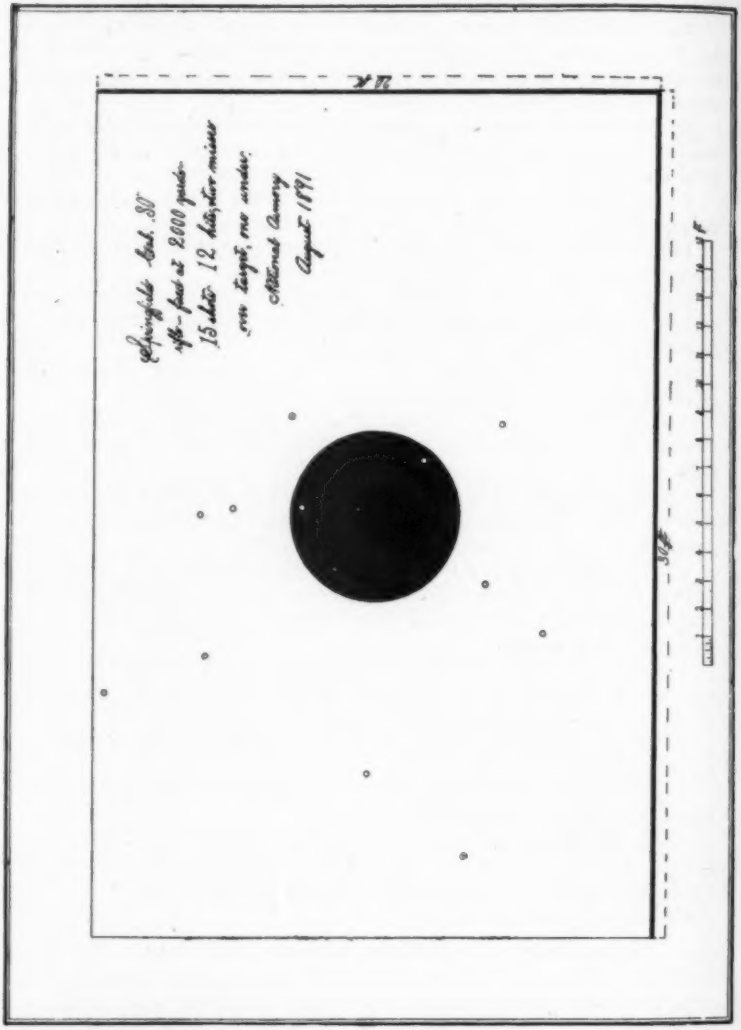
NATIONAL ARMORY,
Springfield, Mass., Sept. 26, 1891.

Dear Sir:

In accordance with your request I enclose a target recently made at this Armory with the small calibre Springfield rifle at a range of 2000 yards.

This rifle in its breech block and receiver only so far differs from the

service arm as to adapt the gun to the smaller cartridge; the length of the barrel and number and depth of the grooves has also been preserved, but the twist has been made one turn in nine and one-half inches.



The calibre 0.30 cartridges were those prepared for the tests now being conducted by the Board on Magazine Arms, their total length is 3.09 inches —0.29 inches longer than our 0.45 calibre—but they are much lighter, 175

of the 0.30 calibre weighing only as much as 100 of the present cartridges. The bullet, a lead slug encased in a copper jacket, weighs 230 grains and is cannelured for the lubricant as in the service cartridge. The shells are bottle-necked, of a diameter under the head 0.05 inch less than the service cartridge and when crimped on the ball about 0.2 inch less. The charge is 34 grains of smokeless powder from the Wetteren factory, Belgium, and gives a muzzle velocity of nearly 1900 feet. In appearance it somewhat resembles gunpowder, but has a pungent odor of pine-apple. On discharge there is a slight smoke which dissipates almost instantly; the report is sharp and loud, sounding at a distance more like the crack of a whip than the heavy, dull discharge to which we are accustomed from the service arm.

The object of the firing at the Armory was to determine experimentally the proper height of rear sight for the small calibre arm; commencing at 200 yards, and then firing at 500 and 1000 yards an approximate elevation for 2000 yards, sufficient for the sighting shots could be estimated.

After the graduation mark had been decided upon, firing was suspended and when resumed next day the accompanying target was made, fifteen shots only, as these reported, being fired, partly by one operator and partly by another, both using a muzzle-rest. Weather almost calm. It will be noticed that the extreme lateral direction was about sixteen feet, the vertical, including the shots missing over and under, probably about fifty per cent. greater.

Such accuracy of fire as here exhibited could of course be expected only under favorable circumstances from expert marksmen, but as it shows the capabilities of small calibre arms using jacketed bullets and smokeless powder at a range formerly considered beyond the limit of aimed Infantry fire it possesses interest and may serve to reassure the Infantry that the new armament so generally adopted abroad and to obtain which for our service measures are now in progress, will restore the effectiveness of their fire apparently threatened by the development of the range and accuracy of the field artillery.

Yours respectfully,

STANHOPE E. BLUNT,
Captain Ordnance Department.

THE MECHANICS OF SEA SICKNESS.—A SUGGESTION FOR THE NAVAL MILITIA.

In preference to this gruesome title I might have chosen for this article one used by Benjamin Robins in 1747—"A proposal for increasing the strength of the British Navy."

Robins proposed that all guns of that date from 18-pounders downwards, should be changed for others of equal weight but greater bore, with reduced charges of powder—for carronades in fact. But the Americans were the first to avail themselves of this valuable idea, and with very successful effect against our ships.

In my article an apparatus is proposed by which any line regiment may be made immediately available for marine service afloat, and a means of indefinite expansion of our naval force is secured—so essential, as history shows us, in any protracted struggle.

With the introduction of steam, the sailor's training is approximating again, as at first, to the military type. The modern man-of-war's man is a seaman gunner, drilled to serve ashore. The chief hard work afloat is now that of the stoker, who replaces the "waister" of the seventeenth century, and to secure a supply of stokers competent to serve afloat immediately, is one of the present problems of naval administration.

By vaccination we produce an artificial small-pox which wards off the real disease; and similarly, if we can produce mild sea sickness on shore, it is reasonable to expect that comparative immunity will be secured at sea. By means of a full-sized cross-section of a ship, suspended by the metacentre, and properly weighted, we can imitate exactly the rolling of a ship, and thus have a swing calculated to produce exactly the same internal sensations.

An ordinary swing is useless for the purpose, as the body is then in the neighborhood of the centre of oscillation, where the disturbing effect is *nil*, or nearly so. It is requisite to have the full-sized ship section, so that we can recede some distance from the centre of oscillation, on the upper decks, and even up on a mast, so as gradually to accustom ourselves to the varying internal sensations.

(The author here shows a cross-section of a ship suspended at M, the metacentre, G being the centre of gravity, and W the weight—in tons, represented by a line through G.) If we draw the curve formed by the centres of buoyancy B then, as Mr. MacFarlane Gray pointed out in his lecture on the Metacentre before the Institute of Marine Engineers, the ship will roll as if the curve of buoyancy rolls on a horizontal plane, just as a cradle rocks on its curved supports; and the metacentre M is the centre of curvature of the curve of buoyancy. The ship will oscillate like a simple pendulum or plummet suspended by a thread from the metacentre.

Now supposing the ship set swinging through a finite angle on each side of the vertical, we have to investigate the disturbance in the apparent direction of gravity at any point P, due to the effective forces of inertia at P. The resultant direction of force will be given by a plumb-line of a plummet suspended at P, if the plumb-line is short, so that its independent oscillations die out quickly. By means of observations on such plummets suspended at different parts of a ship, Sir W. Thompson has proposed to analyze the rolling, and determine the axis of rotation and centre of oscillation.

Professor Philip Jenkins, of Glasgow University, has applied the same dynamical principles to the analysis of the "Shifting of Cargoes at Sea." Thus, if the plumb-line of a plummet at P makes an angle with its mean direction in the ship greater than the angle of repose of the cargo—grain, coal, etc.,—the cargo will shift. Professor Jenkins confines his attention to the shifting effect at the end of a roll, where this effect will naturally be at a maximum.

But we must show how to determine the relative direction of the plumb-line at P for any intermediate position of the roll or swing, as is requisite in the analysis of the mechanics of sea sickness, as the cause of the physiological effects.

(By an ingenious bit of mathematical analysis, which space forbids our

reproducing here, the author shows how to determine the relative direction of the plumb-line through P, and explains why an ordinary swing is useless as an antidote to sea sickness; and generally why the motion is less felt the lower we descend in the ship and the nearer we approach the centre of oscillation.) The further we recede from this centre, by mounting up into the cabins, on deck, or even up the masts, the more pronounced the motion in causing sea sickness. No mere increase in size and apparent steadiness of the vessel can overcome this effect, as the diminished motion is counterbalanced by the corresponding increase of distance from the instantaneous centre of force.

As a cure is impossible, we must seek for prevention, and this prevention can be attained by a little preliminary practice on land, by mounting into such a swing (or metacentric cradle) as that already described, made to imitate, to full scale, the cross-section of a ship, and made to imitate the rolling by being suspended from the metacentre; here the entry door could be made so that passengers could enter and leave at pleasure.

An hour or two in such a swing, gradually increasing the motion by mounting away from the centre of oscillation, with the knowledge that escape was always possible, would go far to inure passengers to the real motion of the sea.

The switchback railway and the *montagnes russes* have had their day, so why should not the proposed metacentric cradle have a similar vogue? and it was a pity that it was not brought forward earlier, in time for the Naval Exhibition at Chelsea (or the descent on Fisher's Island). A small attempt in this direction, in the shape of a steam roundabout, provided with boats which were made to pitch, was seen at the Paris Exhibition; but the motion thus produced does not resemble the real motion on the water.

Furthermore, as a means of increasing our naval power, the ship swing must not be despised. A few of these in our principal seaports would rapidly and economically give sea stomachs to raw naval levies, stokers, marines, or volunteers; not to mention the gun practice which could be carried out from the moving platform of the deck. The chief objection urged against the Royal Naval Artillery Volunteers (and our own naval militia), that they are not sailors—meaning that they would be sea-sick—could now be made to fall to the ground. But principally a few hours of swing drill would suffice to convert a line regiment into marines, or rather, make it capable of marine service.

(A few of these cradles set up on the flats at Fisher's Island, with proper crank attachments worked by a few stout marines, would render the summer descent on that charming spot of much practical value. A section through the poop deck with a gallant reservist mounted thereon, in "full tog," shouting orders through a trumpet, would lend realism to a manœuvre that should be fully satisfying in other regards. At our larger artillery posts a suitable amount of cradle drill would go far to obviate the necessity of turning over the responsibilities and perils of coast defense to the Navy—as suggested in a recent article by one of our unselfish "Sea Brothers." Though it would be a thousand pities to deprive our naval friends of another chance for their cherished tours of "shore duty.")

Up to the time of Trafalgar certainly, all line regiments were liable to service afloat, and the part taken by the sixty-ninth regiment at Trafalgar is well-known, while the French and Spanish ships were full of soldiers, and riflemen in the tops.

In a long naval peace, it is doubtless found more convenient for organization to have a separate body of marines under naval control; but in a protracted war, this organization will, as before, require to be largely supplemented from outside.

Any cause tending to bridge over the increasing gap between the coöperation of our land and sea forces is of importance, when, by the light of history we see the need of elastic expansion to an indefinite extent in a struggle protracted beyond a few first encounters.—A. G. GREENHILL, F. R. S.—*The Engineer*.

Reviews and Exchanges.

Recollections of President Lincoln and His Administration, by L. E. Chittenden, His Registrar of the Treasury.*

THIS book, if not a great addition to the history of the Rebellion, is valuable as adding to our knowledge of our great men; especially so of Mr. Lincoln, and the Secretaries Stanton and Chase. The author's position as Registrar of the Treasury gives true value to his facts relating to our war finance; some of which are quite new, and curious as well as interesting. He recalls to the public its debt to Mr. Chase by emphasizing the fact that the success of the great struggle depended upon a proper system of finance; on a Secretary, careful from the beginning in the economy of the public purse, and in preserving confidence in the national currency. A thoughtless Secretary, presuming upon the supposition of an early ending of the war, might easily have bankrupted the Nation before the war had well begun. He closes his Chapter XXIV with a well-earned eulogy on Secretary Chase, to whose faults of character he is nevertheless clearly perceptive.

Referring to Abraham Lincoln's ungainly person, the writer, whose judgment may be somewhat affected by his admiration of the Greatest Man of History,—thought him eminently handsome. As the reviewer remembers Mr. Lincoln there was in his muscular system, in face as in body, what the sailor would call *a slack*, which when taken up metamorphosed the man. The oft-quoted sadness of expression appeared to be due simply to the slackening of the muscles of the face. He seemed to depend so much on his reserve force that he seldom felt it necessary to take up the slack; hence he ordinarily looked slouchy and melancholy. His early western want of training no doubt had much to do with this, for those early communities rather sneered at style.

In dealing with the Inaugural, in his admiration for his hero, the writer borders at least on the edge of injustice to the President's judges—the political parties of the people. No doubt, in one sense, Mr. Lincoln, by confining himself in his declaration to the support of the Constitution,—acted in the wisest possible manner by acting in the simplest possible manner; in not allowing his tongue to bind him to any hard and fast rule of action in all the emergencies of which the future was to be so rife. Surely, he who had declared that a single country could not exist of two parts, the one slaveholding, the other free, might reasonably have been expected to drop something of a like doubt in his Inaugural. The results of the war agreed better with the forecast of the "pronounced republicans discontented with the Inaugural" than with the Constitution which Lincoln promised there to preserve.

Did Mr. Lincoln comprehend the full force of his remark to the Letcher Peace Commission: "The Union must be maintained if the Constitution was to be enforced as the supreme law of the land"? Doubtful! And yet it was the key-note of the order of the prosecution of the war. Union first, rules of action afterward. A Country

* *Recollections of President Lincoln and His Administration.* By L. E. Chittenden, his Registrar of the Treasury. Harper & Brothers, Franklin Square, New York. 1891.

and a People first, then a Constitution. Mr. Buchanan and Secession were perfectly logical in declaring coercion ultra-constitutional (some said unconstitutional), and it was: the war did not sustain *that* Constitution, it made a very different one. But it made something better than a constitution; it made a Country and a People; and this was the result whatever Presidents or parties proposed to do at the outset.

Now, we all see that Mr. Lincoln's way in the beginning—groping, tentative—was the wise way then, but the "discontented republicans" had their way, at last.

As to Abraham Lincoln's religious views he has in this book a whole-hearted advocate. Without deducing too much from the few reliable facts known, we may conclude that he belonged to the large body of men who think there is something in revealed religion, on which, some day, they will turn their microscopic vision and powerful intellect and evolve something. While awaiting this day, they use the parlance of believers, as they have heard it in their intercourse with their fellow-man, they accept the impress that Christianity has made on society as their standard, but will not put on the wedding garment—yet. Among his reported quotations from the Bible we do not find Heb. x, 25. He was neither Anglican nor Roman in his Good Friday way of showing forth his gratitude for a united country. The weight of evidence appears to be on the side of his belief in the Christian's God and of a revelation. The story is related as a fact, of a good Methodist Perfectionist approaching an old English prelate with the searching, habitual, professional question: "Are you saved?" "We-e-ell, ye-e-es," said the churchman, "I-I-I th-th-ink so, but it was by such a close shave that I don't go round bragging about it."

Whatever Mr. Lincoln's religious views were, he certainly didn't go round bragging about them.

The strength of Mr. Stanton's character is well brought out. The author evidently prides himself on his powers of analysis. He omits a very material point in this, presumably through ignorance. When the Secretary's enemies would try carrying by bullying what they failed in by persuasion, and called him cowardly—first, they never carried their point—secondly, let us hope they were ignorant of the fact that Mr. Stanton during his whole service was a sufferer from heart-disease which threatened to remove him at any moment of acute excitement.

No being, with a particle of cowardice in his composition, could have taken and held so tenaciously, such enemy-making positions. As against charges of temper, cases are known where he was long-suffering and patient to a fault.

The instance related by General Fry when Mr. Lincoln and the Great Secretary took issue, was, we submit, no test of relative strength. Morally, Stanton was undeniably right. Lincoln thought himself to be so politically. Stanton was handicapped in two ways—Lincoln was President, the source of authority—Mr. Stanton, self-convinced of his indispensable usefulness to the Nation, would not resign a position which he felt vital to the Union, to indulge a whim of anger or of personality; he *yielded*, but we may well know him incapable of acceding.

Mr. Stanton as Attorney-General becomes the support that a "President wavering on the question of the legality of the war," needed.

What could be more wonderful than the antithesis between these two great men! and yet the sameness! Lincoln, with strong cause of personal offense against Stanton, yet calling him to his most important aid in the cabinet—and Stanton under any stings of past subordination being able to say, over Lincoln's body: "There lies the most perfect ruler of men the world has seen."

It is hardly fair to the North to say that before the war "the North considered slavery the sum of all villanies." Plenty of that people, no doubt did so think, but still they were a small, however active and talented, minority. The great majority of

the North, in the Middle, Western and Border States reprehended slavery as a cause of increasing estrangement between the sections, independent of the fulminations of abolitionism. Numbers many times superior to the abolition element, men still opposed to slavery in the abstract, so-called conservatives, were quite willing to let the South work out its own problem without interference. The antagonism of this class was at length roused only by the attempts to extend slave territory.

The author's account of General Lee's resignation does not add to the luster of that much lauded character, nor to that of the intimate friends who championed his financial claim. One paragraph we quote: "If between the two oceans that wash its remotest limits, there was one man more firmly than any other bound to the service of the Republic by tradition, training, associations, pecuniary considerations, and the honor of a soldier, that man was Colonel Lee." He also makes a very strong case against Lee for the personal responsibility of the war.

The posing of the Southerner is taken off with great grace. He was always a martyr to Northern tyranny when his plans were checkmated. To those who remember those times it was Tertullus accusing Lysias of taking Paul from them "with great violence." The violence of taking Paul *wasn't worth talking about.*

The exciting scenes, dilatory measures, diverting ancedotes, and the you-have-muddied-my-water of the Southerner are amusingly recounted. The ingenuous humor here reminds one of Le Sage.

The law of South Carolina as punishment for treason against the sovereignty of the State is, we learn, "Death *without benefit of clergy.*" If our country *is* new this shows that it is well chained to the antique. As there never were ecclesiastical courts in that country, to take a man from the civil courts, the question arises, Did the legislators know what "benefit of clergy" means? Or did they mean a new thing, a thing that the English wording had no reference to,—that the felon should not be shrived?

In Chapter XX the Seventh Regiment and Colonel Lefferts are paid the highest compliment.

The writer very fairly scores Roebuck, Gladstone, the *Times*, *Saturday Review*, *et id genus omne*, for their sympathy with the slave-holder. It was so unexpectedly inconsistent. We were forgetful how the almighty dollar so easily finds subterfugial reasons for a change of mere sentiment. Cotton easily proved to England that slavery should be the true basis of society on the ground producing it: that base on which to found a nation of gentlemen, of preux chevaliers, of unconquerable chiefs. Even now the Conquistador of the Fellahin hasn't got over working on the problem, how the hero cavalier, genius, Lee, was beaten by the mudsills, who with only twice his numbers fought all round a circuit of six thousand miles, while he operated on radial lines nowhere exceeding a few hundred. Lately Wolseley is accounting for it by the incapacity of the lowlings, Grant, Sherman, etc. Deductions from his reviews of our war clearly prove that gentlemen who have the full sympathy of enlightened English warriors were beaten by very inferior material, relatively inferior numbers, and on their own ground.

As a people we hold no resentment to England as a people, for the enmity of its commercial and noble classes to us in our struggle. We gratefully remember the sacrifices of Bright and of the operative classes for us. Let us ever remember that proffered loan of one millions pounds in gold, 'spot cash,' to our Minister, Adams, when the Laird ironclads were to be held on injunction. America is entitled to his name, which should be engraven on our highest temples.

But it is a great deal to ask us to forget the humiliation which Roebuck and his partners subjected us to in our strait. When asked to check the cruisers fitting out, he said England doesn't make laws to suit America. At the time, we laid it up as a pain-

ful sting which we were unable or too poor-spirited to resent, but when during the Franco-German war, Bismarck called England's attention to infractions of comity and she plead as formerly, (minus the curt offensiveness of Roebuck) Bismarck demanded the necessary corrections and England found plenty of extra legislative appliances with which to restrict invidious mercantile speculations. Braggarts can always recognize a master hand.

The history given of Governor Letcher's Peace Conference must take a place in the record of the times.

The exciting incidents of the Counting the Electoral vote is a fine bit of description. It also recalls very opportunely what the Union owes to General Scott. It brings the memory of the old hero-patriot back from the oblivion to which the interposing mass of subsequent gigantic crises has doomed it.

In opening his chapter on the two great generals, McClellan and Grant, after drawing a comparison as to their characters for ostentation and simplicity, the author gives Grant's interview with the President on leaving him to take command of the Army of the Potomac. Grant said: "The country should be cautioned against hoping for great successes. The loyal and the rebel armies, east and west are made up of men of the same races. They have had about the same experience in war. Neither can justly claim any great superiority over the other in endurance, courage, or discipline. One may be more skillfully handled than the other; accidents have sometimes won victories and caused defeats. But where two such armies meet on common ground, about equal in numbers, and equally well handled, I do not know why any better result should be expected from one than from the other. In the coming campaign, in one respect, the rebels have the advantage. We shall be in their territory, with which they are perfectly familiar, and we shall be upon strange ground. Their arms are equal to ours, they claim superior discipline and greater endurance. While I hope and expect to defeat them, I do not know why this war should not end as wars generally do, by the exhaustion of the strength of the weaker party."

The writer is evidently not an admirer of McClellan's modes.

Some diversions and characters of the Smithsonian are introduced apparently to show how the great men of all estates could admire Mr. Lincoln's character and attainments. It seems he impressed himself forcibly on these great savants.

In no place has a great harvest of death and suffering been more masterly painted than here by the writer in his account of its procession into Washington hospitalry from The Wilderness. The Surgeon-General gets a lashing for establishing a hospital near the Old Canal, and credit for its removal is given to the newspapers and Sanitary Commission. Presumably, this error, if such it was, could be easily explained, and it would be a very stupid surgeon who should wait for the newspapers to find out the mortality of a locality, or wait for them to urge its correction. The charge sounds like the work of a penny-a-liner.

Colonel Baker and his detective system comes in for strong animadversion.

After reading his instructive chapter on iron-clads one is at a loss to say to whom the idea of the *Monitor* is due; to Gen. Robt. Anderson, Mr. Bushnell, Captain Ericsson, or Mr. Lincoln.

His Chapter XXIII., on the Emancipated Negro is excellent in description and full of quiet pathos.

The battle of Monocacy is brought into the prominence it deserves; its importance is generally neglected in histories, possible from General Early since trying to suppress the real intent of his expedition to screen his failure. It was certainly one of the great crises of the war. Lew Wallace's stubborn resistance gained at least a day and saved Washington. Again, Early's delaying the attack on Fort Stevens on the morning of

the 11th July, from a military point of view, was inexcusable except in one view, to be mentioned further on and was fatal to his success. To the Union it was as providential as was the arrival of the *Monitor* in Hampton Roads, March 8th.

Possibly General Lee spoilt his own success by his warning to Early that the Sixth Corps had started for Washington's defense. This would account for Early's hesitancy.

The author is an intense Vermonter. After reading the book we feel that Vermont conquered the Rebellion, somewhat assisted by General Wright, who again was held in check by Mr. Lincoln from indulging his Regular-like bloodthirstiness.

The article on office-seeking is the best thing written on the subject and should be read and committed by every youth, yea, by every man in our country. It would be a curious, if not an appalling exhibit, if the full estimate could be made of the loss of time, money, perverted talents and morals, in one year of political struggle. Think of what few prizes are drawn, as against neglected legitimate business enterprise, and weep, my brother American!

In discussing General Scott's confidence in Geo. H. Thomas's loyalty, the writer forgets or was ignorant of the relationship existing. Thomas was Scott's nephew. Nevertheless, nobody who ever had Thomas's eye fixed upon him could ever suspect that great good man of disloyalty to anything.

The author writes in a plain narrative, flowing style, vigorous and pleasing. He aims at the "short story" plan or falls into it naturally under the circumstances; they are excerpts and developments taken from notes made "on the spot," are full of "go," and of mental as well as historic meat. There is not a dull chapter in the book, nor valueless *conte*. It will be prized by every library of the land, being an excellent complement to *Hay and Nicolay*.

It is somewhat marred by a general tone of dislike to the Regular Army. He fails in no instance to boast of a victory over the old bureaus, nor to applaud successful interference with red-tape. There is red-tape and red-tape. Red-tape is character. His want of logic is very transparent, for none of his related successes prove that they were best for the service in general, and they show favoritism. No man appeals quicker to red-tape and rules of official routine, than the "broad-minded man" who suffers through any deviation from them. In lauding Mr. Lincoln's mercies, even in the remission of sentence in the clearest case (Scott's, which by the way is an idyl worthy a high place), he does not prove that they were for the good of the service. How would an Article of War like this read: "Any sentinel on picket-duty in front of the enemy, who shall fall asleep on post, *when he can keep awake*, shall suffer death or such other punishment as may be accorded by a court-martial"?

Nobody blames Mr. Lincoln for his exercise of power of mitigation in any particular case, but we certainly protest against the tone of praise the author accords for a wholesale setting aside of verdicts under law, given in the vast majority of cases by volunteer judges, and charged by volunteer officers—when "the safety of a whole nation may have depended on the loyalty, bravery and vigilance of one man."

With the author all old routine was wrong. All the new schemes, vagaries and mountains of trash are vindicated because they brought forth a few practical men and practicable ideas. He considers it unreasonable, old-fogyish, and Regular-like that the Surgeon-General should not have clutched to his bosom the proposed Sanitary Commission. He would have been a ninny to do so: to have confessed *ab initio* that his department was impotent, and that to make it practically useful he should saddle himself with a civic organization that he could never govern; to depend on a commission subject to the fluctuations of public generosity, for that which his office was responsible to the nation to supply to the soldier.

The commission no doubt did much good in the field; many a good drink of —— milk the reviewer had from its stock in camp to the refreshing of the inner man, but the writer's indignation at the Surgeon-General's rejection does not prove that the money would not have been more economically and more conscientiously employed by the medical department. The tendency certainly was to give that department an excuse for not doing its full duty in the way of supply.

A test question would be, With the knowledge of the last war will the Surgeon-General of the next war be anxious to be helped out by a Sanitary Commission, or will regulars never learn anything?

Should a European army be asked to adopt a Sanitary Commission, it would probably accept the Sisters as nurses in hospital; the Brothers would receive a musket and go to the front.

To be sure, like the British soldier in Egypt, (probably he got a lesson from us) our "boys" were a bit exacting. When the English sanitaries supplied Tommy Atkins with delicatessen, he claimed they were nothing without fresh grapes.

It is a pity that the improvements are not mentioned which Mr. Thos. Scott proposed to make in the War Department, and which old army routine trammelled, so that a record of a true business man on true railroad principles might not be lost to the country. However, we will always be able to find loads of such men ready to supplement the inexperience of unpractised regulars. Mr. Cameron evidently made a great mistake in not keeping him and revolutionizing army administration.

We wonder if the heads of bureaus when they came away from the President and Secretaries with their decisions countermanded felt defeated. In ninety-nine cases out of a hundred it is reasonable to suppose that they left the audience indignant and disgusted with the favoritism they saw and were impotent to check. It may be added here that very little of this was successful with Mr. Stanton.

The description of the Belle Isle prisoners as returned, brings up that horrid feature of the war. We say and believe that we had or have no feeling of hatred for our Southern brother, before, during, or after the fight, but the most liberal of us must stop, consider, and confess that we are unable to account for Belle Isle, Richmond, Andersonville, and Salisbury on any principle of American manhood. If there was a policy in it, it were better never to uncover it. Weeping Charity, bleeding at every pore, casts her veil over this enigma of man's inhumanity to man.

JOHN HAMILTON,
Colonel of Artillery (ret'd).

"War," by Colonel F. Maurice, Royal Artillery.*

This is a reproduction of the article "War" in the Encyclopædia Britannica, with some few changes and one important addition. The work will find a place in many select military libraries from which the Encyclopædia has to be excluded. It is comprehensive in its scope, clear and concise in its language and popular rather than professional in its style. In short, it is the science of war with all the wrinkles rubbed out. But in spite of its many merits it has defects which cannot be overlooked. Many of the author's deductions will meet with opposition and some of them certainly deserve it. But such opposition will only serve to advertise the work. There is nothing so delightful to a professional reader as finding fault with a professional author. Doctors not only disagree, but seemingly take delight in doing it; and the peculiarity is not confined to the medical profession.

The author—p. 1—says, in effect, that inventions and discoveries in the weapons

*War. To which is added *An Essay on Military Literature* and *A List of Books*. By Colonel . Maurice, Royal Artillery. Macmillan & Co., New York.

and material of war determine the character of tactics. Few will dispute that assertion. But when he goes on to say—p. 2—that "the development of arms has changed the moral pivot of military power," we beg to differ with him. The "moral pivot," or as we should prefer to call it, the centre of spiritual force, remains where it has always been. Discipline may be affected by inventions and discoveries but the fighting spirit is independent of all material things. The spirit of a game-cock is not affected by putting gaffs on his own or his adversary's heels. Neither is the soldier who has a fighting spirit, or any aggregation of such soldiers, demoralized by the armament of his adversary. War is a spiritual as well as a physical contest, and the spiritual element is the more important whether the battle is waged between armies, school-boys or chicken-cocks.

Men are imitative animals. It has become the fashion to write up the methods of the victor in any great battle or campaign, and then to look upon the production as regulations for waging successful war. This is quackery; base imitation; the body without the spirit of war. Frederick's system was so written up and proved a failure, and so was Napoleon's. The military copyist is the sorriest copyist of all, because there never were and never will be two military problems exactly alike. The copyist simply follows the treatment which a master of the art prescribes for some other disease. This is not scientific treatment.

Of course discipline and tactics are essential in war. They are the means by which armies are brought to the scratch. The army with the better discipline and tactics will come to the scratch in better order than its adversary. It will be less shaken than he. But the battle remains to be fought, and it takes a stronger power than discipline to control the contestants after the battle is joined. The nations of the earth have remodeled their drill-books according to the latest regulations for waging successful war, and may have to repent it. The regulations remain unproved. A locomotive engine may run very well down grade, and be utterly unfit for up-hill work. We should like to see "The Dispersed Order" playing a losing game before we shout "Eureka!" over it.

We cannot regret the prospective abandonment of fortifications as a consequence of the use of high explosives for bursting charges. (IX. X) The absurdity of erecting conspicuous targets for an enemy's artillery to practice at has been apparent to many artillerists ever since the introduction of long range guns with enormous power. That smokeless powder is likely to make the absurdity generally apparent is not be be regretted. We think concealment better than bombproofs at long range and the sooner fortifications become simply holes in the ground, undistinguishable a hundred yards away, the better.

But we prophesy a wider range of usefulness for high explosives than the author seems willing to accord them. An army may so establish itself in a defensive position, as to be almost impregnable. Is its adversary bound to make it his objective? May he not send heavy cavalry raids armed with high explosives to devastate the country to which it belongs? This may look like a return to barbarism.—Explosive shells were so looked upon once,—but it is really a motion in the interest of peace. In these days of democratic ascendency the people are the war-making power, and they ought not to grumble at the consequences.

A raiding column of well-mounted cavalry, armed and equipped for destruction rather than battle, might sacrifice itself—if that was necessary—to much greater advantage by operating against the railroads, telegraphs, supplies and productive industries of a hostile nation, than by charging impregnable positions on his chosen battle-field. The author says—p. 1—"The laboratory and workshops of science in recent years, have in fact produced and forced a change in the method of fighting." We admit it, and suggest the method above outlined. The cavalry would then become *the* aggressive arm.

It is easy to set up the impossible as a standard and demand that practical men work up to it. This is a favorite trick among military theorists. But the author fairly takes our breath away when he says—p. 6—that the object of training is "to make each man ready when required to apply sound principles in every emergency, and above all, as soon as possible voluntarily to place himself under authority again so as to secure unity of action."

That is certainly a startler. An army of heroes might be a possibility; but an army of professional experts, "ready when required to apply sound principles in every emergency," is worthy of Captain Bobadil himself. When such an army puts in an appearance we shall be ready to admit that "the moral pivot of military power" has really changed its locus. Just think of an army of von Moltkes! Splendid conception no doubt; but where can we get the recruits?

The author says—p. 1—that moral force is "the determining factor" on every battle-field; but he gives us no definition of it. What is moral force? And what has training to do with it? We have read about demoralized armies,—perhaps we have seen something of the kind—and we have a distinct recollection of a demoralized soldier. We have also seen demoralized soldiers, re-moralized—if we may be allowed to coin a word, to express our meaning—and doing heroic work, for hours, with steady nerves. How was it done? God only knows. The presence of some one seemed to do it. Some men seem to be storage batteries of moral force, and their mere presence exerts a mysterious influence on the hearts—not the heads—of men. Reason has nothing to do with it. Where such men command demoralization is impossible. But training has nothing to do with it. Moral force cannot be trained into any man. It is excited by the proximity and power of some grand centre of moral force, but it cannot be created. And wherever such a grand centre exists, *there* exists a "moral pivot of military power." If it be in the commander we shall have unity of action. If it be distributed among the men we shall have diversity.

Discipline is a much misunderstood word. If it is the homage of a weaker to a stronger spirit, it manifests itself in cheerful, willing and unlimited obedience. If it is the offspring of fear it manifests itself in a limited obedience less cheerfully and willingly rendered. Discipline of the latter sort is known in the Army as "State Prison Discipline." Discipline of the former sort is really a manifestation of spiritual loyalty, and therefore improperly named. With spiritual loyalty pervading its ranks and grades from top to bottom, an army becomes a living organism perfectly adapted to the work it has to do. We accept the author's conclusion, "That a living organism must take the place of a mechanical instrument,"—p. 6—but we would apply the language to the army, and not merely to the individuals of which it is composed.

We agree with the author also, when he says—p. 11— "That only by study of the past experience of war has any great soldier ever prepared himself for commanding armies"; but the statement would be untrue if we substituted "man" for "soldier" in the sentence. The student must be a soldier to begin with before he can study the art of the commander. Then he must study until it has "become with him an instinct almost, absorbed into his blood, to be of value to him"—p. 10. But, can an instinct be acquired? Would it not be more in accordance with fact to say, If the instinct for command exists in the man, it may be developed by study? It is just as impossible to learn to be a commander of men as it is to learn to be a poet or an artist. Of course copyists may be made. But copyists are not artists. Military copyists are only Kriegsspielers; great generals until the hour of trial comes, and then great failures.

Almost on every page we find something which we should like to quote and comment on did space permit. On page 20, "The handling of armies is, before all

things in the infinite variety of its elements, *a dealing with human nature* under certain peculiar conditions, a play of mind against mind." The italics are ours. There is a heap in that sentence. Masters of the Art of War have been readers of men rather than readers of books. They read history as the Christian reads the gospels, that they may have fellowship with their brethren who have gone before. Few men can grasp all the "peculiar conditions" which any military situation presents, and those few have not acquired their ability from books. The commander who knows nothing that he has not learned from books, is apt to be a barren fig tree.

It is not pleasant to be told that strategy, the sublimest part of that "play of mind against mind" which constitutes the Art of War, is unstable in its nature. The author says in effect that it has been changing and must continue to change with the character of armies and the conditions under which they operate—pp. 11–24. But the unpleasantness disappears when we discover that it is the methods and not the principles of strategy to which he refers. Principles never change.

The newspaper press has become a disturbing element in war. The author says—p. 17—that MacMahon's march to the relief of Metz "became known to the Prussian Headquarters through French and English journals." Now, as secresy is the soul of strategy, MacMahon's movement was rendered, not only abortive, but disastrous, by newspaper *enterprise*, as it is called. The war correspondent can do much evil: can he be made to do some good? Commanders of armies strive to deceive each other; might they not make the newspaper man help. Artistic lying is an important factor in war. It is not a new factor. All great commanders have used it. To be effective, the liar must believe he tells the truth, and newspaper correspondents might be used as innocent mediums in this part of the contest of "mind against mind."

The chapter on strategy will bear several readings, not so much for what it contains as for what it suggests. Every paragraph, almost, expands into a treatise, under reflection, and memory readily supplies illustrations from history or experience.

The question, How far subordinate commanders may be permitted to depart from the letter of their instructions? is too important to be decided on the experiences of a single campaign. That it was done without disaster in the German armies during the campaign of 1870–71 is not sufficient warrant for its general adoption. The conditions which prevailed in that army are rare. The spirit of *loyal independence* exhibited by subordinate and tolerated by superior commanders, was the offspring of a mutual knowledge of character, and confidence in each other's ability, good faith and sound judgment acquired in previous campaigns during the annual manœuvres for a series of years. Then they all acted under the supervision of a Sovereign present on the spot. It would be unwise to permit any such latitude in an army where the higher commanders are professional strangers to each other. We doubt very much if *loyal independence* is possible in any Republican army. Still the higher grades of commanders should be given the opportunity of knowing each other professionally. We heartily agree with all the author says on this subject—p. 42.

That "Discipline is the very life blood of an army"—p. 43—will not be disputed by any military man. Still, in view of the strain which modern weapons impose upon it within their danger zone, and the difficulty, not to say impossibility, of driving men into the deadly zone by means of it, some inquiry into its exact nature is justifiable.

Admitting, then, that "the instinctive habit of obedience to a word of command"—p. 44—for which English soldiers of the olden time were so distinguished, constitutes the principal ingredient in military discipline, we may be permitted to ask, upon what does that obedience rest, and how is it cultivated? And the answer must be, fear of punishment. The foundation, then, upon which the habit of obedience which has been called military discipline is built, is the "hangman's whip." Military disci-

pline is the obedience induced by cracking that instrument. In battle it is effective to a certain point: that is, to the point where it becomes just as dangerous to obey as to disobey. Beyond that point it is impotent.

The danger zone may be traversed under discipline. The deadly zone requires a more potent force. But men have been carried across the deadly zone. Under some mysterious influence which makes them forget fear, they follow their leader into the very jaws of death. What is that mysterious influence, which makes a man forget the instincts of his nature and do with steady nerves what he would shudder to contemplate were he not so acted upon? Surely "the moral pivot of military power" must have something to do with it. For the time being the soldier is in a condition akin to hypnotism, and the exciting cause is in the heart of the commander. It is the spirit of command, the commission which the Almighty Ruler of the Universe confers on every natural leader of men. Sham commanders have no such commission. They must depend on the hangman's whip, and when that instrument has reached its limit their power is exhausted.

Dispersion and control are the antagonistic elements at present disturbing the tactical schools. Dispersionists deny the necessity of control, and the advocates of control forget the necessity for dispersion. Both parties have solved the problem of tactics, and, as a matter of course, both solutions are wrong. Perhaps the true solution is a mean between the two. We are not sufficiently acquainted with Colonel Macdonald's system to pass upon its merits, but from the author's description of it—p. 54—it seems to rest on sound principles. It seems to recognize the merits of dispersion, and carries control down to the lowest unit. Control cannot be dispensed with. Dispersion may be necessary, but it must be kept strictly within the limits of control. If it is not, the functions of tactics must end when the real battle begins. If the battle is successful, all right. If it is unsuccessful, all wrong, and no remedy or refuge left.

The author says—p. 55—it is not wise "to write drill books in the study"; and we should like to add, *nor upon the experiences of a single successful battle or campaign*. The military world is altogether too fickle on the subject of tactics. We have not forgotten what Napoleon is reported to have said on the subject. But we believe that the same system is not the best for all nations. Study the character of the people before prescribing for them. Copy nothing. Adapt the drill to the roughest ground. Have as few movements as possible, and do not bother about their having a French flavor or a German taste. Success in war depends "rather on the condition of men's minds than on the efficiency of weapons,"—p. 58—and, we should like to add, "perfection of tactics."

The author's remarks upon cavalry are outside our province. It is difficult to believe that the glorious rôle played by masses of cavalry in the battles of Napoleon are utterly impossible on modern battle-fields. The author refuses to believe it, and we heartily wish that we were able to follow him. But, while we concede weight to his arguments, and accept Prince Kraft's deductions as theoretically true, the question, Would it pay? must be answered in the negative. Cavalry can be more profitably used in some other way.

As to artillery the author adopts the views of Prince Kraft, *en bloc*, which is the safest thing to do, perhaps, at present. Still, it must not be forgotten that the Prince's experience was all on the winning side. His views might have been much modified if he had been afforded an opportunity of applying his prescriptions in a losing battle. If the Germans had been beaten at Gravelotte—and they ought to have been—what would have become of their artillery, and their army, for that matter?

From page 77 to page 83, we have a restatement of the conflicting evidence as to

the material effect of artillery fire. Those who suffered defeat say the artillery did it. Distinguished parties find nothing in the lists of killed and wounded to justify the assertion. But these disinterested parties take no note of moral effect. At Wörth the French batteries were worsted by the German artillery and compelled to withdraw, and that fact demoralized the infantry line against which the artillery as yet, had hardly fired a shot. At Gravelotte, Canrobert's infantry advancing were met by German artillery fire. It did them but little damage, but as they had no batteries with which to reply, they halted and Canrobert reported that they could advance no further. At Sedan the French were subjected to an artillery fire to which they found it impossible to reply, and although it was doing but little damage comparatively speaking, the Emperor and the army surrendered. In all these cases it was the moral and not the material effect which was decisive.

We have left ourselves no room for remark on the Essay on Military Literature except to say that it is a very valuable professional paper, but a little disheartening to the young student who has a burning desire to master the literature of his profession and knows that he must retire from active service at the age of sixty-four.

JAMES CHESTER,
Captain 3d Artillery.

"Bethlehem Armor and Recent Armor Experiments at the Naval Ordnance Proving Ground."*

This is a reprint from the *Iron Age*, of March 19 and June 4, 1891, of a portion of a paper read by Mr. W. H. Jaques before the Iron and Steel Institute at the May meeting, 1891. In it Mr. Jaques gives an excellent *résumé* of the armor question during the past year, and discusses the question, in some of its aspects, from his own point of view. He is an ardent advocate of steel armor as opposed to compound iron backed armor, and he modestly plumes himself on his record in this matter. He can easily be pardoned for a personal sense of satisfaction at the present status of the armor question, as he has from the first on all occasions cried out in the most positive terms for steel armor, and stood opposed to compound iron backed armor. We, on this side of the Atlantic, owe more to Mr. Jaques and Mr. Very than to any others for whatever has proved to be sound in our ideas of armor. In 1886 Mr. Jaques published "Modern Armor for National Defense," and in it are to be found the germs of most of the advanced features of the armor question at the present time. This paper of Mr. Jaques with Mr. Very's "Development of Armor for Naval Use" undoubtedly influenced the armor legislation that occurred at about the time of their publication, and they were potent factors in the discussion that led finally to the decision that steel armor should cover our new war-ships. While, therefore, Mr. Jaques is in position to congratulate himself on his record in this matter, he is, because of this, entitled to speak with some confidence as to the conditions of the armor problem at the present time, and the probable line of development in the near future. He does this in the pamphlet before us.

In referring to the Annapolis competitive trial, he takes occasion to answer the oft heard explanation of the poor showing of the Cammell plate, namely, that it was not up to the standard of the type; he says: "the arguments that have been offered, that haste in delivery or deficiency in manufacture have rendered them inferior to those of current make, should not be allowed to enter. The manufacturers ought to guard their own interests by sending the very best plates they can make."

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* *Bethlehem Armor and Recent Armor Experiments at the Naval Ordnance Proving Ground.* By W. H. Jaques, late of the U. S. Navy.

Mr. Jaques very justly takes Mr. W. H. White to task for not securing the publication of full accounts of the *Nettle* experiments, and of the 4-inch nickel-steel plate trial he has referred to in public. For three years we have been waiting for the complete accounts of the *Nettle* trials, and nothing except scattered fragments coming from the plate-makers themselves, have, as a rule, become known on this side. It may be doubted whether England gains by her secresy in these matters as much as would come to her from a free and full discussion of the trials such as has taken place in the case of the Annapolis trials. In reference, further, to the *Nettle* trials, Mr. Jaques argues, from the standpoint of the British, that it would have been in their interest to have admitted a Schneider plate on the conditions named by Schneider, namely, that in case of success an order be given for the the armor of one ship; he says very aptly: "you have given an order to Messrs. Vickers because the success of their all-steel plate warrants it, and I believe you would do the same thing without hesitation to Messrs. Schneider."

The author devotes considerable space to pointing out the many opinions existing as to what should be the measure of the ballistic resistance of a plate, and illustrates how authorities have vacillated from one position to another, now insisting that cracking is the one thing that must be avoided, and, again, asserting that it is unimportant provided penetration is prevented and the pieces do not leave the backing. After discussing the matter to some length, he formulates his own idea, thus: "In the order of merit those plates should be entitled to first place which show the greatest resistance against perforation, have the least penetration, do not expose the supporting structure, break up the projectiles, and (since all plates cannot be tested ballistically) can be manufactured so as to secure the most uniform results."

In this connection he states that he still advocates the compound steel plates which he favored in "Modern Armor for National Defense," and he excites much interest by the assertion that he "hopes soon to be able to state that it has been brought to a successful issue by experiments now progressing."

Mr. Jaques considers the Harvey process of face carbonization to be full of promise, certainly a move in the right direction. He gives a detailed account of the trial of the Schneider 10-inch plate treated by the Harvey method which took place at Annapolis on March 14, 1891. He also gives the data connected with the ballistic test of the first plate of heavy armor manufactured by the Bethlehem Iron Company, and in order to accomplish a proper comparision of the behavior of these two plates before a. p. projectiles with that of the three plates in the Annapolis competitive test of September, 1890, he gives photographic reproductions of all five plates after the tests.

The Harvey-treated plate broke up Holtzer steel projectiles in about the same manner as the untreated Creuzot plate breaks up chilled iron projectiles, and it would appear that this face-hardening process restores to armor when attacked by Holtzer projectiles the advantage it formerly had over chilled iron projectiles. The next move must now be made by the projectile makers, and it is likely that the Harvey process applied to projectiles, or some new departure, will bring projectiles up again to the relative position they occupied last year at the Annapolis trial. We need not expect that the pendulum like swing of advantage between projectiles and plate has ceased.

The reproduction of the Bethlehem plate reveals a marvellous uniformity and a high measure of resistance. The plate, although only the first, is evidently well up to the Creuzot standard. It is a cause for national congratulation that such a high standard of armor can be produced at home. If a harder face can be given to the metal of this plate by an application of the "compound" principle—as Mr. Jaques intimates

the Bethlehem Company hopes to be able to do—there is little doubt that Bethlehem armor will place itself well abreast of the Harvey-treated plate, provided the scaling-off tendency of compound plates under attack can be avoided in the compound steel plates advocated by Mr. Jaques. E. M. W.

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ARTICLES ACCEPTED FOR THE JOURNAL.

Army Reorganization, - - -	By LIEUT. A. D. SCHENCK, 2d U. S. Art'y.
Reminiscences of Tonquin, - -	By LIEUT. F. DE T. CLOTH, French Navy.
Development of Rapid-Fire Guns,	By LIEUT. G. W. VAN DEUSEN, 1st U. S. Art'y.
Army Transportation, -	By COL. J. G. C. LEE, Q. M. Dept., U. S. Army.
Infantry Fire, - - -	By LIEUT. GEO. B. DAVIS, 23d U. S. Infantry.

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Announcement.

AT a general meeting of the Military Service Institution, held on Friday, September 11, 1891, at Governor's Island, N. Y., pursuant to notification duly given in previous numbers of the JOURNAL, the question of amending Sec. 4, Art. IV. and Sec. 2, Art. V. of the Constitution of the Military Service Institution was put to vote; and as more than the required two-thirds of those voting, voted in the affirmative, the amendments were declared carried.

The Articles as amended read as follows:

Art. IV, Sec. 4.—All persons not mentioned in the preceding sections, of honorable record and good standing, shall be eligible to *Associate Membership by a confirmative vote of two-thirds* of the members of the Executive Council present at any meeting. Associate members shall be entitled to all the benefits of the Association, including a share in its public discussions; but no Associate Member shall be entitled to vote nor be eligible to office.

Art. V, Sec. 2.—There shall be an Executive Council, consisting of the officers aforesaid, *ex-officio*, and one representative from each Staff-Corps and Department not represented by a Vice-President; two representatives each from the Cavalry, Artillery and Infantry arms, and one representative from the retired list: *Provided*, that these proportions may be disregarded if, in any case, there should not be officers from all such branches of the Service available.

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The affairs of the Institution shall be conducted by the Executive Council which may make such By-Laws, not inconsistent with this Constitution, as may seem necessary.

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Quartermaster's Dept....GEN. S. B. HOLABIRD.
Subsistence Dept.....GEN. J. W. BARRIGER.
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HISTORICAL SKETCH OF THE SIGNAL CORPS, U. S. ARMY.

By LIEUT. W. A. GLASSFORD.

Signal Corps, U. S. A.

THE genesis of military signaling is written in the labors of Myer. What from the most ancient times other commanders had dimly comprehended, Napoleon first saw clearly enough to crystalize into his maxim, "*Le secret de la guerre est dans le secret de communications.*" What the great captain of modern warfare recognized but could not attain was the problem whose solution fell to Albert James Myer of the Medical Department, United States Army. In all campaigns from the remotest times the maintenance of communication by transient signals had presented itself to commanders as of paramount importance, but in practice it had eluded them. When simple the signal was inefficient, when efficient it was so unwieldy as to be impracticable ; the flashing shield at Sunium and the fingers of Chappé's semaphore were alike in their unavailability upon the field of battle. The waving flag and torch of Myer were the first contribution to the solution of the problem which were efficient without cumbersome machinery, and while so simple as to be easily extemporized from any chance materials were yet capable of performing every service which they could be called upon to render.

From the flag and torch of the enthusiastic inventor to a highly developed corps of the general staff is a long step. To show how it was taken, to present some of the more striking features of this growth, rapid in the heat of battle, to sketch the plan on which the Signal Corps was built, this chapter of the history of the war has been written from study of the compiled Official Records of the Union and Confederate armies.

In the beginning, the corps was enfolded in the enthusiasm and determination of Myer. In fact there was no corps, but there was Myer. A chief without a corps, it was his consuming ambition to surround himself with a staff of trained assistants; he succeeded in his ambition in 1863, but such were the animosities excited by his success that he was removed from the command of the corps he had created and in 1864 was out of the Army. Yet such was the influence he was still able to exert that he prevented the confirmation of Colonel Fisher twice appointed to succeed him. It is with the period between these two phases of signal service that most of this sketch has to do.

Dr. Myer entered the Army in 1854 as an assistant surgeon. His active interest in sign language, already displayed in his graduating thesis, was manifested at once by its development into a system of signal communication, for in 1856 he drafted a memorandum of his device. This, however,

attracted little or no attention at the War Department, and not before 1858 was the inventor successful in bringing his plans before a military board duly authorized to consider them. Yet another two years of exertions, strenuous though unrecorded, passed by before Congress created the position of signal officer of the Army. On June 27, 1860, Myer was gazetted Major and Signal Officer, the first known to history, and the first acknowledgment that the Napoleonic maxim was worthy a place in practical military science.

Within a fortnight he was despatched to the plains. It is interesting to note who ordered the duty and to whom this inventor of the latest feature of military art was sent. It was Floyd who wrote the order, it was Fauntleroy of the First Dragoons who commanded the Department of New Mexico to which the signal officer was assigned; within a year they were both under arms in the Rebellion, and the signal officers of the Confederacy were conveying messages on Myer's system in the very front of Washington before the National Army had fairly realized that it had a signal officer. Fortuitous as this coincidence may be, Major Myer on reaching his distant post was ordered to participate in the Navajo campaign in Colonel Canby's command. Here again the senior officer designated for a course of signal instruction and to act as assistant in the field was among those who joined Floyd and Fauntleroy. This expedition in the severest rigors of mid-winter upon the mountains of New Mexico proved a test which showed the new signal system to be capable of all that was claimed for it. The test which proved the system satisfactory must also be regarded as a test of the author. The examination of what he did in this campaign gives a clue to his successes as well as his failures in the graver war which followed, and the test is a more than fair one, since it is judging him by his own standard.

Myer was an enthusiast, but his enthusiasm was often expended on trivialities. Strong on details he was weak on great principles. Having founded his system of signal communication upon a code of three elements he failed to grasp the induction which should have led him higher. He was diligent in repeating the same three elements in all sorts of guises; having developed the system for the eye he devised codes to appeal to the other senses of touch, hearing and even of smell. He multiplied instance upon instance and repeated needlessly the demonstration of that which was already proved. In connection with the torch he was minute in measuring the diameter of the flame-shade and its linear distance below the wick. He attributed the failure of his dial signal-telegraph train to the fact that curious soldiers cut the trailing insulated wire to see what it was made of; he could not be brought to see the inherent inefficiency of an apparatus which could not be made to work over ten miles of wire, even if uncut, because wrong in principle.

It is essential to a proper comprehension of the corps in the early chapters of the war to understand these traits of the man who called the corps into being. How he did it, how he induced the creation of a staff corps, how he was himself overpowered in the very success, these are matters which appear in the Rebellion records, here a piece and there a piece with many gaps which demand close attention to fill them up.

When in 1861, war unexpectedly broke out Major Myer was prompt to suggest the practical value of signals to the Army, and on this account he was called from the west, since the patriotic zeal at headquarters would neglect no chance that gave even the faintest promise of assistance. In Washington there was haste to meet the emergency so suddenly thrust upon the Army not yet recovered from the paralysis of wholesale resignations. Little was known of the new military device and Myer found officials too busy to give much attention to his plans. Lights appeared on the Virginia hills by night and waving flags by day, a device of the enemy. Incomprehensible to all others and menacing, these things were clear to Myer, who renewed his efforts under this stimulus and succeeded in gaining the official ear. A course of signal instruction was initiated on June 10, 1861, at Fort Monroe, where eleven subaltern officers detailed from the forces near that post were hastily instructed in signal duties. This course continued but a few weeks and came to a sudden close when Major Myer was ordered to the Department of Northeast Virginia, and called upon to establish communication without being allowed a single trained assistant. Blunder as it was, yet it was fruitful in results, since nothing short of the spectacle of the Signal Officer of the Army idle upon the field of Bull Run, could avail to show those charged with the conduct of affairs, that the individual signal officer is valuable only as a part of perfected machinery. However, rudely acquired, this knowledge led to the establishment on August 30, 1861, of the Signal Camp of Instruction on Red Hill, Georgetown, D. C., a permanent institution where under the diligent charge of Lieut. Samuel T. Cushing, who was associated with Major Myer in the Navajo campaign, signal parties were instructed and equipped to attend each army that took the field.

Established under these circumstances, the activity of the Signal Corps during the war can best be studied in connection with the great military operations of the campaigns which it so materially assisted. Reference to the general maps of the war will show the Confederacy to have held possession of the interior lines of communication, a decided advantage, the want of which imposed upon the Federal commander grave inconvenience and considerable hazard, in that it enforced upon him the necessity of attack by widely disconnected armies operating in regions equally separated. Comparing all the campaigns it may in a broad way be said that the Federal attack was directed midway between the four cardinal points. Hasty movements began the attack upon the northeast where the valleys of Virginia, Maryland and Pennsylvania were the theatres of the hardest fighting. In the southeast, the coast of Florida, Georgia and the Carolinas formed another point of attack. Louisiana and the lower Mississippi were the scene of the southwestern attack. The assault upon the northwest moved along the great military lines of the Tennessee and the Cumberland. Any study of the growth of the corps during the war will involve the necessity of tracing its history in each of these approaches to the heart of the Confederacy.

This method of examination of the materials at hand, while sacrificing unity of time, yet in its stead renders it possible to present in clear terms the independent but co-ordinate development of four bodies of signal officers, each in its own field. This in due course of time made it possible for Major

Myer, as with intent to bring about a uniform degree of signal efficiency throughout the armies, to embody in a single centralized corps these organizations which were practically as independent of him as of one another. The period comprehended within the scope of the more detailed part of this paper, is that during which the system of regimental signal officers obtained, which was concluded in 1863 by the act creating the Signal Corps to continue during the Rebellion. However successful the system of signals proved itself, it must be seen that the plan of detailing regimental officers crudely instructed broke down completely under the strain of actual campaign. One of the most distinct lessons of the war is this which appears unmistakably in every report.

Recurring to the four columns of inquiry a brief presentation will be made of the development of signals in each up to the period noted. This happens most opportunely to correspond with the limit of the Rebellion records thus far published, beyond which it is not deemed advisable to push a detailed inquiry in which the chances of error are considerable.

Instruction at the Georgetown camp had been but a few weeks under way when the Signal Officer was called on to detail officers for an expedition then fitting out at Annapolis for an unknown destination. This was the beginning of the operations on the southeast at the close of 1861, and the expedition was that commanded by General Thomas W. Sherman against Port Royal in which the signal officers were efficient in maintaining communication and won for the signal system in a particular degree the commendation of the Navy. Early in 1862 signal officers accompanied General Burnside's Roanoke expedition and secured a foothold upon the coast of North Carolina. Thereafter, during 1862 and 1863 the Signal Corps was present at the operations in the two Carolinas with ever growing efficiency. It must suffice to indicate in broad outline the growth in the southeast quarter up to the time when the corps was placed upon a solid basis, which corresponds closely with the engineering successes before Charleston. The beginning was small at Port Royal; at Roanoke the signal officers did no signal duty at all and won mention by volunteer service as aides. From this humble start the progress in the next eighteen months though slow was steady, and as the novel service won, little by little, the confidence of commanding generals, it was stimulated to greater efficiency. The result attained is apparent in the reports of the chief acting signal officer of the Department of the South which detailed the events just prior to and including the fall of Fort Wagner and Battery Gregg, the approaches to Charleston. It is shown plainly in his record of events; but more prominently yet in the attitude which he seems to have felt justified in assuming toward officers his superiors in lineal rank, and in the freedom with which he called upon the other staff corps to render him assistance in erecting the ingeniously constructed signal towers which overlooked Charleston harbor and roads.

The scanty record of signal operations in the southeast presents one difficulty,—lack of material; the record in the northeast, being voluminous, presents another and even harder difficulty, that of selection and condensation. Major Myer, who was designated Chief Signal Officer of the Army of the Potomac, published in 1864 his report of its two-year-old signal opera-

tions, written with less reference to its military value than to its political bearing upon legislation then under consideration in Congress. From these records, diffuse in details and silent as to essentials, it is a hard task to arrive at the methods by which the Signal Officer proposed to utilize the military results of his actions, in firmly establishing his own position which as yet had not emerged from the insecurity which must attach to any experiment.

On this northeastern approach there was some signaling done in 1861; the officers instructed at Fort Monroe put their lessons into practice, but they contributed little to the success of these early engagements. But in 1862 the Signal Corps, after its full winter's training at Georgetown, was as eager to press on to Richmond as any portion of that luckless army. Myer moved with his corps; he saw what each man did and made a note of it; nothing escaped his attention and few events but were made to contribute to the greater glory of the new arm of the service. He diligently recorded that on the voyage down the Potomac the Signal Corps prevented marine disaster; at Yorktown it became in the person of its officers, prominent by reason of the incessant waving of their flags, the target for artillery practice; it served at intervals in the Seven Days Battles, and that the service was interrupted was the fault, not of the system, but of the battle clouds of smoke; it changed its base to the James and directed the gunboat fire at Malvern; it fell back with the rear guard from Richmond with the great army to which it was attached. At every step, after the corps had done anything noteworthy, Myer insured the future of his system by securing a letter to that effect from the general or flag officer who had seen it done.

Another Signal Corps at the same time was operating with Pope's army at Cedar Mountain and Second Bull Run as it had done in the early spring with Banks at Strasburg and Winchester, but its history is obscure, since its successful work was not heralded by Myer's reports until the Army of the Potomac moved north in September. Then came the operations about Frederick, Md., the engagements at South Mountain and Antietam, in all which the corps was efficient in its proper function. With these northern battles the signal operations assume a status of more real value and are better recognized by commanders; Fredericksburg brings the corps prominently to the dangerous front, Chancellorsville shows Hooker making intelligent use of this body of trained officers both to observe and to communicate, and at Gettysburg the Signal Corps is acknowledged as firmly fixed in the military household by Meade's circular before the battle, in which he calls upon this as upon all other staff corps to aid him in the impending engagement. First appearing as an idle spectator at Bull Run, later summoned to the council of war at Gettysburg, these two facts tersely illustrate the two years' growth of the signal system on this front.

In the southwest the signal officers, like the son of Achilles, came late to the war. When Farragut ran Forts Jackson and St. Philip no signal men were with him, nor did they come until the first assault was over and New Orleans was occupied by the Federal forces. It was not indeed until 1863 that the Signal Corps made its mark in this field of the war. Having had just enough duty in small skirmishes to bring it into efficiency, it invested Vicksburg and Port Hudson with Grant and Banks; from its towers

and treetops it covered the beleaguered towns with vigilance ever alert; it saw every movement in time and gave warning to the besiegers, for whom it was not only eyes but tongue as well.

The beginning of the war on the northwest was most distinctly marked by the failure of signal operations, not so much by reason of any inefficiency of the system, as through the chapter of accidents which so greatly retarded military operations upon that approach. The first signal party was sent to General Halleck at St. Louis late in March of 1862, but the use of this new military art was not fairly appreciated, and the detachment was soon dissolved. At Shiloh, Grant's army had no signal officers; Buell's had, but almost the sole mention of their activity is that they were ordered back to duty with their companies. At Perryville the record shows that the signal system was in operation, but by a strange mischance it did not succeed in conveying to Buell the knowledge that a battle was in progress. But an improvement was noticeable when on the last day of 1862 Rosecrans fought the battle of Stone's River, and found his signal officers to be relied upon in the discharge of their proper duties. Thenceforward the progress was distinct, the service was growing in efficiency and in reputation, and in each regard an improvement may be noted after Franklin, Tullahoma, Chickamauga, Lookout Mountain, Missionary Ridge and Knoxville. In a year and a half the Signal Corps had, from a position in which it was treated with indifference, advanced in this army also to the burden of grave responsibilities, in which it proved itself deserving of the reliance placed upon it.

On the Confederate side signal officers were no less active, although the close details of their operations exist only in fragmentary reports. It has been already remarked that the Confederate army made earlier use of signals than the Union forces, and that the sight of their flags and flames on the Virginia hills served to hasten consideration of Major Myer's plans. The Richmond Congress early recognized the value of this service and drafted a measure which authorized the creation of a Signal Corps of consistent and comprehensive efficiency. Under this act the Signal Corps of the Provisional Army of the Confederacy was instituted and placed in charge of Major Norris. The plan was excellent but when it came to putting it into operation it would seem that of the two duties of the signal officer, observation and communication, which the model signal officer of the future must combine, Norris, not being actuated by the inventor's enthusiasm, devoted his attention to the former. The reports of Norris' bureau which have survived are in the majority of cases the details of scouting exploits within the Federal lines; the system seems to have grown into a matter of high-class spying in which the commission and uniform were expressly designed to serve as a cloak to the operations and to enable the operator, if captured, to offer a specious plea against the customary penalty of spying. To perform the legitimate duties of signal communication there grew up another body, the Independent Signal Corps under Major Milligan, which operated in Virginia and North Carolina, and probably enjoyed a still wider field.

In the four fields of war in which the signal officers prosecuted their operations the work in this formative period was done by acting signal officers,

that is, subalterns of volunteer regiments detached for this special service. To understand their position attention should be directed upon the enactments and orders which authorized their employment on this duty. The act of 21st June 1860 created the position of Signal Officer and announced rather than defined his duties. In 1861 the commanding generals of the several departments to which in succession Major Myer was assigned, detailed junior officers to be instructed in signal duty; thus originated the school at Monroe, the experimental stations along the upper Potomac, and the permanent camp at Georgetown, all being authorized by orders and confirmed upon an essential point by the act of 22d February, 1862, which settled upon officers so detailed the pay of cavalry officers of the same grade. Thus the Signal Officer obtained his first corps.

There was about this corps, as in all new projects brought about by the personal efforts of any enthusiast, an element of uncertainty, it was of a temporary nature. officers detailed might be recalled to the line by the order of their regimental commanders or by their own wish, above all there was no appropriation directly made for the service rendered. One remedy was applied, the order of the War Department that acting signal officers should not be relieved from that duty except by order of the Adjutant-General of the Army. This was palliative, it secured the corps against rapid depletion, but it did not remove the causes which led to such depletion, nor did it secure the corps a permanent status. It still presented the anomaly of but one Signal Officer in the Army and all the work of signal communication performed by acting signal officers. To remove this anomaly, to acquire a permanent status with an eye to inevitable retrenchments of the peace-footing in the future, engaged the best efforts of the Signal Officer. This system of regimental officers detailed for signal duty had the most fair trial, it was tested by the exigencies of actual campaigning and this test was continued for two years; in this length of time its merits, if it had any, should have been made overwhelmingly manifest, its faults should have suggested their correction. But the two years experiment showed the faults too deep-seated for correction short of radical reconstruction, the merits expected were uniformly absent. Every battle, every movement of troops showed defects, and proved them to be inherent in any corps of signal officers which depended for its existence upon regimental details. Yet, following his plan of utilizing every method which might popularize his system, he succeeded in having a course of signals prescribed at the Military Academy in July, 1863, and added to the instruction in visual signals a course of lectures on telegraphic communication, and to aid that purpose sent to West Point a train with the Beardslee instruments.

Myer's system was a novelty in military practice; there had been no opportunity to exhibit its utility to the army in general; New Mexico was far away and in 1861 men had other things to occupy their minds than waving flags in a fruitless Indian campaign; worst of all not a line about the duties of the Signal Officer was found in any text of the art of war, and not yet had the lesson been learned that war well made makes its own art. The unknown system was nowhere welcomed, at best it was tolerated, in many cases it had to encounter the dogged resistance of rigid formalists.

Time and the event had not yet proved its superiority in its twofold sphere; the scout for observation and the orderly for communication were yet supreme. Like Napoleon, who rejected Fulton's project to transport the French army across the channel by steam power, few could sufficiently project the new arm of the service into the future to give Myer support in his efforts. Where improvements in the methods of observation and communication failed to affect the result, it was necessary to seek still further modes of usefulness in which the Signal Officer might be free from old traditions. It must be recognized that Myer was diligent in grasping at every means that might even remotely assist him, and characteristically pertinacious in returning to his purpose with unabated vigor after each rebuff.

The chance of the times and the events incidental to the hasty mobilization of great bodies of raw levies, zealous as they were unskilled, offered the first opportunity. The disasters of Big Bethel and Glasgow, where troops fired deadly volleys into the ranks of their own comrades, sadly showed the inability of new volunteers in the peril of panic to know friend from foe. While the feeling of horror was still fresh, Major Myer came forward with a system of countersign signals which should prevent similar deplorable catastrophes. The system was adopted and promulgated in general orders. Regimental commanders were to have their adjutants and color sergeants instructed to wave by day the regimental colors in certain fashions and to burn colored fires by night. There were then two hundred and fifty organizations in the single Army of the Potomac, and they were all instructed during the winter of 1861; but the time and labor were spent in vain. The system never gained a foothold, and properly lapsed as better training in the duties of the soldier removed the causes which had operated to bring it forward.

A second attempt to attain, first, prominence, and next, permanence, brought the Signal Officer in contact, not this time with apathy and indifference of commanding officers, but with the lively opposition of a civil bureau of the War Department already well established and decidedly indisposed to yield to the pretensions of Major Myer. This was the attempt to secure control of the telegraph upon the field and in its relation with the army. The attitude which the civilian operators assumed, seems to have been prompted not so much by the belief they professed in the essentially civil nature of their calling as by their personal objection to Myer, who had not served an operator's apprenticeship, and who did not have that peculiar touch by which an operator comes into electric sympathy with his fellows in the profession.

Governed in this by sentiment rather than by reason they made a mistake; the mistake they then made they have since acknowledged, and have pleaded it in support of legislation sought in their behalf. The men who were most strenuous in opposition to military control of the telegraph, are now on record as supporting just that control and discipline in campaign. It must be admitted that Myer was personally unsuited for telegraph duty; moreover, it must be admitted that had he been suited for that duty history would have been different. Similarly of the few nations which attempted to

perform military telegraph work by force of civilians, all have realized the practical impossibility of the attempt. Every nation except France has transferred the service to the army, and even in France the transfer will soon be brought about inasmuch as schools for the instruction of officers and men have been established.

The creating act of 1860 explicitly authorized the Signal Officer to have charge of all signal duty and all apparatus connected therewith. This language was General Butler's sufficient authority for assigning Myer to the charge of the recently constructed line of the U. S. Military Telegraph in southeastern Virginia. The order was distasteful to the regularly appointed superintendent of the line, who believed himself to be accountable only to the War Department. But communication with Washington was practicable only by letter, and disobedience to Butler's order would have been quickly visited with heavy penalties; on this account the operators made temporary submission. The Signal Officer's tour of duty as telegraph officer was brief, and he was sharply reminded by the Secretary of War that electric telegraphy was not in his province. This was the first skirmish of a bitter contest.

Myer now made a formal demand upon the War Department to be given control of the entire system of military telegraphs under the terms of his commission, but it was at once apparent that he would not be allowed to interfere with the electric operators. His attention was accordingly directed upon some portable system of telegraphy operated upon other principles than the Morse system, and even in his early plans he seems to have appreciated the important differences between the flying telegraph and the semi-permanent lines. Having discovered what he sought in a magnetic dial apparatus, the Signal Officer in August, 1861, laid before the Secretary of War a plan for signal telegraph trains which should not interfere with existing interests, and yet, by a clause judiciously inserted to the effect that a proper proportion of the officers and men should be selected electric telegraphists employed for the war, it was carefully devised to secure Major Myer a permanent corps in the place of the acting signal officers, and, by securing a sufficiency of Morse operators attracted by actual commissions or the prospect of winning them, to place him in a position to make a more effectual demand for the control of the military telegraph. This was met by an authorization to purchase a small telegraph train to communicate with points which could not be reached by signals, and fixing upon the Signal Officer the responsibility of determining the necessity for such a train. Major Myer hesitated to act under this authorization, which was silent as to any appropriation. In March, 1862, the Beardslee or magnetic instrument had not been brought into condition to use, and the question of an electric train was beset with difficulties when the Signal Officer was ordered to take the field with no definite arrangements concluded.

Under these circumstances little could be done with this branch of the equipment in the Peninsular campaign, and what little was attempted was touched upon very lightly by Major Myer in his personal report, although this is the first mention in all history of the telegraph on the battle-field. It was not until the close of the year 1862, at Fredericksburg, that any definite

attempt was made to bring into special prominence the telegraph train of the Signal Corps. This dial telegraph was maintained in intermittent operation, and for the most part was favorably reported by the officers in charge. In May, 1863, at Chancellorsville, the field telegraph of the Signal Corps was in operation. Practical test demonstrated the line to be insufficiently insulated and incapable of working except for short stretches, while the instrument was slow and particularly sensitive to atmospheric disturbances. But the gravest difficulty was that it here came into direct and disastrous competition with the electric military telegraph of the War Department, and offered itself to the critical judgment of such men as Eckert, Stager and Bates, who were in a position to pass upon it the criticism of technical experts.

Under the influence of sundry successes achieved in the summer campaigns, the last month of 1862 saw the appropriation of funds sufficient to construct several of these telegraph trains. The same causes contributed to produce a result of greater importance than the supply of field telegraph trains. This was the permanent organization of the Signal Corps.

The authorization to construct signal telegraph trains was, in its very nature, a solace to Major Myer for refusing him control of the U. S. Military Telegraph to which he claimed title. He had been in conflict with Secretary Stanton and had been worsted. There could have been no better recommendation to the sympathies of the Congress of that time. Avoiding any chance of reference to the more purely military committees, which would be to a certain extent under the influence of the powerful secretary, the legislation was accomplished in the Sundry Civil Bill which became law on the 3d of March, 1863. Thus was the Signal Corps built and equipped with a systematic organization.

At the head of the corps there was a chief signal officer, a colonel, who should be Signal Officer of the Army, there was a lieutenant-colonel and two majors, there was one captain and eight lieutenants for each army corps, and for each officer there was allowed a sergeant and six privates. The corps was authorized for the duration of the Rebellion, and appointments were to be made on the recommendation of examining boards. In accordance with the report of the first of these boards Major Myer was nominated Chief Signal Officer and given a recess appointment. Later in the same year the Judge Advocate General wrote an opinion establishing the status of the corps as of the establishment of the regular army. The realization of Myer's ambition had yielded to his persistence, he had secured a higher rank and his corps would be permanently established as soon as the examining boards had completed their work in the several military departments.

But Colonel Myer in the moment of success had to learn that the War Secretary could not be trifled with in safety. Once again the Chief Signal Officer sought to obtain a certain control of electric telegraphs, and to that end advertised his willingness to give commissions to telegraph operators Thereupon the blow fell. On the 10th of November, 1863, Colonel Myer was relieved from command of the Signal Corps and ordered to the Mississippi. He turned the bureau over to Major Nicodemus, who was later promoted to the lieutenant-colonelcy, and, most important of all, the Secretary of War ordered that the telegraph trains be put in charge of the Superin-

tendent of the Military Telegraph, Colonel Anson Stager. Thus was the Signal Corps built; but when the cap-stone had been laid in place the edifice passed away from him who built it. Myer was not only banished to a remote military division, but the Senate failed to confirm his appointment; the President revoked it, and the first Signal Officer, the inventor of the art, was no longer in the Army.

It is to study the growth of a staff corps from a single officer to a highly organized body, rather than to make a record of the deeds of the signal officers or a roster which should give them the credit they earned, that this paper has been written. In pursuing this line of research it has been necessary to pay strict regard to the operations of the Signal Officer of the Army and to weigh his official acts as presented directly in the official records of the rebellion, and as reflected in the services which his subordinates rendered in obedience to his orders. A study of the later period of signal operations will afford an opportunity to return to, and present in detail a narrative of events which cannot fail of interest. This chapter is of necessity drawn closely about the personality of the first Signal Officer, for it was in and through that personality that the Signal Corps came into being.

Freed from the guiding touch of its inventor and foremost advocate, the Signal Corps nevertheless maintained a steadfast activity during the war and grew in favor, as it conscientiously discharged its invaluable duties. Major Nicodemus, temporarily placed in charge, had control until the end of 1864, when he too was visited with punishment. He had published his report for that year without having gone through the formality of submitting it to the Secretary of War, and for that offense was dismissed the service on the ostensible ground that he had aided the enemy by divulging valuable information. His innocence of any wrong intent was made manifest soon afterwards, and, it perhaps becoming apparent by what influences he had been hampered, he was reinstated in his regiment of the regulars. He was succeeded in the Signal Bureau by Colonel B. F. Fisher, who was given a recess appointment as Signal Officer of the Army, and when that lapsed, through failure to receive confirmation at the instigation of Myer's friends, was at once reappointed on the same terms.

While affairs of the Bureau at Washington were thus kept in a permanently unsettled condition, the corps in the field was winning fame. At Allatoona its services were so distinguished as to win brevets or actual promotion for all who participated in the battle. When Farragut overcame the fort, the torpedo and the ram, the defenses of Mobile, he sent his army signal officers below and bade them assist the surgeon in the cockpit, for they had been assigned to him only for the purpose of opening communication with the army after the naval victory had been won. But he could not keep them there, the needs of battle overtaxing the naval signal system, forced him to summon them to give him aid. They found their proper station on deck, and aloft as the fight grew fiercer. The admiral ceased to look upon his signal officers as idlers; in his moment of greatest need, when the *Lackawanna* having once through accident collided with the flagship and was returning to the disastrous charge, the admiral called to Lieut. Kinney who had been detailed to his vessel, "Can you say 'For God's sake' by signal?" Then

followed the hasty and historic message to the *Lackawanna*, "For God's sake get out of our way." As the armies closed in on the vanquished enemy the Signal Corps closed in with them until there were no foes to fight; then it was mustered out and absorbed in the body of citizenship, proud to have been pioneers in a new military art whose value none will now dispute.

By way of a conclusion, which is at the same time a commentary upon the methods employed in building the Signal Corps, reference may be not improperly made to a sketch, hastily outlined, that was designed to establish for the Confederacy a signal corps founded on ideas of making it a body efficient in proportion to its purely scientific character, an ideal which has indeed been reached in the present Signal Corps of the Army, but reached only after many years of painstaking endeavor. In a memorandum submitted to General Beauregard in November, 1862, Joseph Manigault, signal officer of the department of South Carolina, outlined the plan for securing to his corps the management of telegraph lines of the army. Incidentally he referred to the education, the reliability and the scientific training of the signal men as fitting them to become a bureau for the transmission of military information; and since they would necessarily have a certain electrical equipment, that they were in a position to assume charge of electric mines and the management of the electric light, and, in short, might properly become the electrical corps of the army.

If Myer fell short of these broadly philosophical plans for a Signal Corps, which should conquer all opposition by the very weight of its scientific attainments practically applied to the exigencies of actual warfare, it is not that those ideas were yet in the future. It is shown that practical experience had suggested those ideas to one signal officer; that the same, and even greater, practical experience did not suggest those ideas to another is not the fault of the ideas nor the fault of experience. But had the case been reversed, had the ideas of Manigault found a welcome in the mind of Myer, it is probable that this chapter of the building of the Signal Corps had been written in far different form, and the history of the corps in the later times would show far more done, far less that had to be undone.

It is pertinent to add that to Myer fell the construction of a second signal corps. The act of July 28, 1866, fixing the military peace establishment, enacted that there should be one chief signal officer with the rank of colonel, but it made no provision for a corps other than by a limited detail of six officers and not to exceed one hundred men from the engineer battalion. The lessons of experience were left unheeded,—it was as though the war had never been. The conditions were of the utmost similarity, with the sole exception that the absence of the war rendered it feasible to formulate a comprehensive policy and elaborate its details in a wise and thoughtful manner. But Myer did not choose to study the record of history. The first step in his construction of the first corps was paralleled by his first act in the construction of the second corps; he again organized his corps by details of acting signal officers and thereby exceeded the provisions of the act, which limited his choice to engineers; two years of war had proved the defects of such a system to be beyond remedy, a quarter of a century of peac has barely sufficed to effect its removal from the corps of to-day. The parallel

may be pursued still further. It has been shown that Myer, failing to secure immediately for his first signal corps the dignity which its intrinsic merits would have won for it in due time, sought to win consideration by assuming duties foreign to its legitimate province, and thereby destroyed that which he wished to secure. A similar method marked his plans for the development of the second corps, for his own language declares this unmistakable purpose "the main question is not how to curtail the corps but how to enlarge its scope and consequent usefulness to the varied industries of the nation" To the legitimate duties of military signaling he added the utterly foreign concerns of the meteorologist, with a result well known. The military side of the corps found its chief activity in the system of military telegraph lines, which was extended along the frontier and which has been maintained to the present. This telegraph system was designed to secure necessary communication where the commercial lines were not available, and its lines have been withdrawn when private enterprise, finding its advantage in the country thus opened, has removed the pioneer burden from the government. In 1878 the act of June 20th made provision for the appointment of two second lieutenants chosen from the sergeants of the corps, recognizing their services by the promise of a military career. In 1880 the Signal Corps was advanced to equality of consideration with the other staff corps, and its chief was given the rank of brigadier-general. This comparative review is timely. The present Signal Corps stands to-day at the point where the Signal Corps of the Civil War, its predecessor, began to crystallize into a recognized auxiliary of modern war and gained that glory of which it may well be proud. Two years of battle brought to that a permanent organization and a singleness of purpose in the prosecution of its proper duties and of those alone; twenty-five years of peace have brought this to a point where extraneous occupations have been renounced and defective constitution rectified. As the two formative years of the first corps, despite their faulty methods, were filled with military activity, so in this formative quarter century of the present corps, military duties have been prosecuted despite the foreign occupations which Myer grasped. Under the earnest endeavors of signal officers the crude device of the flag and torch have developed into the ingenious yet simple mechanism of the heliograph and the flash lantern; the defective machinery of the early dial telegraph has given place to the portable field telegraph, and the telephone and the Morse key have been advanced to the skirmish line. All signal duties have been studied, some have been practised to a perfection reached by no other army, and in this the heliograph system stands preëminent. The Indian campaigns in which the Signal Corps has participated exhibit this fact most forcibly. In the Apache wars in Arizona the signal detachments from their stations on the mountain tops have discerned the most stealthy movements of the enemy and have flashed the news to headquarters or moving bodies of cavalry, enabling the troops to change instantly their direction of march to conform to that of the enemy or to be massed where danger threatened, and even to meet the Indians with their own favorite manœuvre of the ambuscade. With equal distinctness these campaigns have shown the weakness of the system of regimental instruction and details, for in the Geronimo campaign it was found neces-

sary to call upon the Chief Signal Officer to assign technically trained members of the corps to render the duty which proved too great for the unskilled. Despite the continued record of failure of the system, both in the Civil War and in the several Indian wars, the War Department has shown a disposition to maintain the same fallacious idea, and to this is due the repetition of the successive failures of the system of regimental instruction and details.

If the lesson is not drawn sufficiently clear in our own military history, the same principles appear in the policy of foreign armies which have borrowed the art of signaling from us. No matter how much the foreign systems may vary among themselves they are all copied from the Signal Corps of this army with that imitation which is always the sincerest flattery. They have adopted the code, the cipher, the train, though modifying them to suit their own needs; but one feature they have uniformly not copied and that is the regimental detail. Even where their signal services have not been dignified by a separate corps organization, they have at least formed a distinct division of some corps already in existence, such as the engineers, and the practical exigencies of war have in general served to make them independent in all but name.

The permanent Signal Corps is now built on a foundation substantiated by the double test of war and peace, and it is in a position to relieve for the second time the line of the army from the burden of drill and study in the purely technical and special duties of signal communication. It is now possible to progress to a development of the legitimate activities of the signal officer, to observe and to communicate; in war to watch the forces of the enemy and to keep the army advised of hostile movements; in peace to watch those whom the chance of a day may make enemies, to study what preparations they are making and what advantages they hold, and to keep the army advised of these matters; in short so to utilize its energies that as in the field the army will rely upon its signal officers for information, so in peace the army will confidently turn to its Signal Corps for its military intelligence.

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A PERFECT FOOD

For the healthy or the invalid. Unequalled for Beef Tea, Bouillon, Soups or Sauces.

GENERAL AGENTS FOR UNITED STATES,

ROBERT SHOEMAKER & CO.,

PHILADELPHIA.

Established Facts:

That the ROYAL BAKING POWDER is the oldest and purest baking powder, and the greatest in leavening strength.

That it is free from every injurious substance.

That it makes lighter, sweeter, more nutritious and healthful food than any other.

The Royal Baking Powder Company refines its own cream of tartar in its own mammoth refinery, and thus insures its unvarying quality.

> There is used in the manufacture of the Royal Baking Powder more than half of all the cream of tartar consumed in the United States for all purposes. This is required and must be chemically pure, and chemically pure cream of tartar could not be obtained in the markets of this country or Europe, which necessitated the building of special works, and the employment of special processes.

All other baking powders, when analyzed, show traces of lime and sulphuric acid, which arise from the impurities of the materials bought in the market, which their manufacturers use.

This is why the Royal Baking Powder is the only absolutely pure baking powder made.